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ISMAIL PASHA, KHEDIVE OF EGYPT.

THE current history of Egypt affords a singular illustration of the progressive force of national life in this century, wherein the dream of ages is dispelled by new facts, and the dormant energy of man is rekindled. The late Viceroy Mohammed Said Pasha had excited deep dissatisfaction at home, notwithstanding the spirit of enterprise he possessed; and when the expected tidings of his death became a historic fact, and the thunder of cannon from the citadel announced to the startled residents of Cairo the accession of His Highness Prince Ismail Pasha, son of the celebrated warrior Ibrahim, conqueror of Syria and Arabia, the people assembled in vast numbers at the palace to welcome him by acclamations, passing before him in continued streams. Business for three days was suspended, the streets and bazaars were brilliantly illuminated, and Cairo made itself merry.

He proved himself equal to the occasion, when the Consulate representatives of all nations appeared before him on the 20th, by delivering an able address, thanking them for their good wishes, expressing his desire to be at peace with all nations, and intimating his conviction of the importance of developing the natural resources of the country, by promoting agriculture as the great element of wealth, by extending the area of cultivated land, and improving the position of the cultivator; he announced his sympathy with all enterprises conducive to the general welfare and prosperity. He had, during the reign of his predecessor, been intrusted with the administration of affairs in that ruler's extended absence on a visit to Europe, and in the discharge of his function had displayed great ability, and exhibited habits of close attention to business, thereby acquiring the reputation of being the wealthiest of Egyptian princes. It was also his determination to apply the resources of steam power in whatever way it could be made available. His Highness's sugar factory at Rhoda in the upper country was known as the finest in Egypt; and in horticulture his elevated and refined taste made the gardens attached to the private palaces abound with the choicest and rarest plants, the choicest in the world.

Ismail Pasha was born at Cairo in 1830, and educated in Paris, from whence he returned in 1849 and assumed a political attitude in public affairs which, while it brought its attendant dangers, developed his powers. It was in 1855 he accepted a confidential mission to France, and afterwards proceeded to Rome to convey some magnificent Oriental presents to the Pope.

The importance of cultivating the commerce of Egypt engaged his immediate attention. Said Pasha, whom he succeeded, had the most honest intentions in the same direction, but lack of moral courage, and a tendency to listen to large and visionary projects, caused great embarrassment. In, for instance, the growth of cotton he saw the opportunity arising from the want of supply in Europe caused by the American War, and strained

every nerve to stimulate the Egyptian supply as a substitute and as a permanent article of commerce, but the result of his toil was to choke up the store-houses because of the want of means of transit. Ismail had shown his dislike to speculative enterprises conducted impracticably, and commenced his reign by directing the construction of railways to relieve the glut, and permanently provide against its repetition, doubling the lines, and ordering that every available steamer should forthwith be engaged in sending the supplies of cotton and other produce up to Alexandria.

Upon the projected Suez Canal the new Viceroy did not look with the sanguine interest of his predecessor, not caring much for the scheme itself, and disliking the policy of his uncle in dealing with the Company. When, on acceding to power, the question of his views became promptly demanded, he directly blamed the French Consul for his hasty application for any promise on the subject, refusing to give a premature statement of the course he might take. This declaration drew upon him a coldness from the French Court, which tended still further to embarrass the early history of M. Lesseps' design, by placing the Viceroy in a position of seeming hostility which he did not intend. The fact was, that in the arrangements for providing labour at the Suez works a most repugnant condition, as far as he and his people were concerned, had been made, whereby unpaid or rather forced labour had been covenanted for; and that principle he, like every one who has the slightest faith in developing a nation or an idea, knowing it to be a fatal blunder, determined to end at once. His antipathy on that ground did not escape the notice of M. Bouvenal at the Consulate interview, and the dry answer of the Viceroy showed his intuitive perception and exposed the card.

However, the Sultan of Turkey being supreme, that monarch determined on a visit to the new holder of the Suzerainty, who had been to Constantinople to be received. He could not afford to be indifferent to the not disinterested remonstrances or diplomatic hints from Paris, or the not disinterested jealousy of England, concerning the Suez Canal; and, moreover, it became him to see that interference with traditional covenants, customs, and observances did not occur unnoticed in his dominions. No absolute monarch, and surely no Turk, should be chargeable with a want of fidelity to prerogative; that could never be. It was very evident that in Ismail Pasha there existed a spirit of independence which cared very little whether the Sultan happened to be pleased or offended, and which would lead its possessor to acts of self-reliance that might awaken an Egyptian dynasty from the dream of ages to the confusion of Mahomet and his children. These combined influences prompted the Sultan, or rather under these circumstances he resolved, to visit Egypt, and to show to that subjugated country the quality of its ruler; but as the visit could not be altogether Oriental, but necessarily involved an European interest centering on the disputable enterprise, he availed himself of the English reputation for skill; and he invited the society of Hawkshaw, our engineer, that a judgment might be formed on the future of the undertaking of the late Said Pasha with M. Lesseps and his partners.

Besides this there had been disturbances in poor Arabia—that land of the desert, the poet, and the traveller—and the sound of war there could indicate but little blessing to "a sick man;" he must require the Viceroy—the Khedive of the future—to repress all disorder. How could he, so recently made a manifested centre of European policy, permit a race of Ishmael that Mahomet had conquered become the centre of disturbance, involving Egypt and Turkey, and in its disturbance reproducing the Napoleonic idea, which comprised the possession of the Mediterranean Sea. So he went to Egypt, and faced the intelligence, activity, and independent convictions of an active and perspicacious mind. He had in the interval directed the Viceroy of Egypt to repress the present tumult by an order in March, only a month or six weeks after power which that sovereign had, we might say, forestalled, so that, on the Sultan's arrival at Cairo, the business centred in the European question, which Lesseps in his political insight had made the most important in the then active political world, and in the future control of the dependent districts of Egypt upon the ultimate rule of Constantinople—a dream which faded away and left the future Khedive the ruler of Arabia, and the master of the waters of the Red Sea.

And here we cannot afford to pass without notice the intellect, perseverance, diplomacy, and honesty of M. Lesseps. In spite of all the *savans* of Europe he held fast to what we know to be the fact, that the two seas—the Red and the Mediterranean—were one; and that history, in spite of all the talk about sea-levels, made no mistake in declaring it. The insight concerning politics he had shown in the unaccountable proceedings of Napoleon and Oudinot at Rome in 1848—when the Emperor made his real shipwreck by repressing the cause for which, as a youth, he had drawn his sword—taught Lesseps the impotency of his sovereign, and his subordination under conditions to an European arrangement. He, therefore, engaged the Russian, Austrian, Prussian, and Italian Governments to aid him in his French Company; but England declined the *imbroglio*. When Ismail Pasha took the sceptre a new arrangement became necessary, as we have shown; and then Lesseps, who knew the pliability of Napoleon under difficulties, obtained a quasi-agreement between the French and Egyptian powers concerning the future of his enterprise; which agreement, although in form hostile to the Viceroy of Egypt, so changed the basis of power by its construction and by its stipulations as to liberate the one from a portion of his suzerainty, and in return gave him a significant and imperial control over the property, leaving M. Lesseps and his French Company to fight the future financial matters as best they could. That future M. Lesseps had the perception to forecast must ultimately come to the English, to whom he invited his friends to look for capital, encouragement, and patronage in regard of the result.

When the Sultan arrived in Egypt, in March 1863, he commenced the inspection of the works of the Company, and in recognition of the position of his viceroy changed the name of the place at the head of the canal, known as Temsah, which by the operations for uniting the seas had grown into a town, to Ismailia—in honour of the new inheritor of the dominion. But his visit to Egypt cost him much. In the first place it cost half a million of money, which is a heavy sum for such a voyage as that from Constantinople to Cairo, Suez, and Alexandria; then the Pasha of Egypt had nothing to do with Turkish Bonds—at that time so much in British favour as to be eligible for trustee investments—and had quite enough to do in financial affairs in arranging to meet the obligations of Said Pasha. The Sultan gave him the honour of visiting his relation's tomb, and offering prayers at the tomb of the great Mohammed Ali; and on his return approved the design of the Canal, but rejected the condition of slave labour, thereby showing that his interview with the Viceroy had only strengthened the hands of that potentate. In the land of enchantment—for such is Constantinople and the Bosphorus under illuminations and other state accessories—the return of the Sultan had a recognition which had all that brilliancy could afford to give effect, and all that a full hour's cannonading could demonstrate to give him welcome, while from every vessel in those charming waters there glistened millions of miniature lamps, and the public buildings claimed their recognition in an outlined illumination under the night sky. Mosques, minarets, and temples displayed their coloured lights, and made a bright reflection in the waters of the Bosphorus of the Sultan's marble palace; and fireworks and rockets from a floating raft added to the fleeting magnificence of the welcoming home of the sovereign.

Meantime the Viceroy had his own thoughts, his own plans, his own future. He could not be beguiled into a recognition of interminable tutelage, and must even in very loyalty look ahead, and prepare for a future which would surely come, and in its advent might peril his political status and his financial honour.

The originality of M. Lesseps' plan exposed him to every form of suspicion and incredulity; and had he not been a Frenchman of integrity he would, in all probability, have thrown up his case in disgust. But the tenacity of an inventor, and the skilled mastery of diplomacy, sustained him against the opinions of Stephenson, who represented England, and Nigrelli, from Austria. The ancient canal had been cut through the loose lowlying sand much farther eastward, and no doubt soon became choked. The French engineers under Napoleon, who desired a highway to the East, came to the erroneous conclusion that the two seas were of different levels to the extent of thirty feet. The modern engineers proved that opinion to be unfounded; but the possibility of constructing a canal through sand at all did not commend itself to the judgment of either of the three gentlemen save Lesseps; and thus he was driven to adopt his own plan, and appeal single-handed to France for aid in forming his Company. As before stated, the conditions consequent upon this could not but be irksome to the new Viceroy; and, as the political career of Lesseps incurred the displeasure of the Court party of the Empress, a rupture impended which threatened the whole enterprise. He prohibited slave labour at once; litigation ensued, and that ended in an appeal to Napoleon, who gave his award in July 1864; under which the Khedive obtained the abrogation of the offensive conditions made in 1856, and the abandonment by the Company of the marginal lands included in that arrangement, and the Suez Canal shareholders were compensated by an indemnity of fifty-four millions of francs. From that moment the Viceroy gave every aid in his power toward the vigorous prosecution of the works. Port Said, at the Mediterranean entrance of the Canal, had no existence in 1862; it has now a population of 11,000. Three huge stone piers of more than 2000 yards in length jut through the shallow waters into the Great Sea like the sides of a wedge, the sea end

being 800 yards in width and the shore 1550 yards; but one side projects still further in an arc of 1100 yards, to protect ships from the action of the winds as they enter the Canal, and to be a temporary harbour in any emergency. Within this is an inner refuge of more than 4000 yards area, and over all is a light-house nearly 200 feet high.

The first 20 miles are cut through loose sandy shallows at a width of 100 yards and a depth of 25 feet, inclosed by a bank 15 feet above the surface, the surrounding waters being of an average depth of 5 ft. These works lead to an 11 miles structure, and necessitate cuttings of 20 and 30 ft. in depth, ending in a small lake, from whence by another cutting of 11 miles, of a depth of 50 to 70 ft., the Lake Temsah is entered. Here stands the town before mentioned, called after the Viceroy Ismailia—a place created by these works and occupying the central point of the length—and, being connected by its railway with the Egyptian system, must continue to grow in importance and prosperity. All the European comforts are to be obtained there, and its water supply, in common with that of the villages, is brought by a canal from the Nile. Leaving this lake the Canal runs through a level ground of 45 ft. above the sea for eight miles to the locality of the ancient Bitter Lakes, and the cuttings are often more than 60 ft. deep, and in one place almost 90. The quantity of sand and mixed clay displaced to make a cutting 150 ft. wide, and of this length, is scarcely to be reckoned; and the machinery employed cannot be described.

When this cutting had ended and the old waters reached, the next trouble was embanking, for those lakes were as low as the intended Canal. After that region had been traversed came a stony district of 13 miles, through which a cutting of the average depth of 50 ft. had to be done before the old town of Suez was reached. The whole work stands now as one of the marvels of our century. Its perfect success has surprised all who took an interest in the undertaking, although the engineers in 1865 declared, after a scientific examination of the works then in progress, that its ultimate completion was only a question of time and money.

Of the many public works and improvements projected and carried out under Ismail Pasha the Dry Dock at Suez ranks as first in importance and utility. The navigation of the Red Sea had been impeded for want of dock accommodation at Suez; vessels requiring cleaning or extensive repairs had to be sent to Bombay, a journey of fourteen or sixteen days, or, if the case happened to be very urgent the vessel had to be beached, to its great risk of further damage. A very extensive trade had grown up since the culture of cotton in India and Egypt, and great numbers of small vessels were employed. It was nothing unusual to see twenty-five steamers there, where only a short time before that one alone sufficed for the trade, and the expense the Viceroy's government put itself to in constructing a new dock not only benefited the foreign traders but reflected much credit on the new Viceroy. The ceremony of opening it took place in December 1866.

On the 30th of January, 1867, Admiral the Right Hon. Clarence Paget performed the investiture of His Highness with the Grand Cross of the Order of the Bath as the Queen's special Envoy sent out for that purpose, and accompanied by many officers in uniform and a squadron of the fleet. It took place at Cairo, where Lord Paget addressed the Viceroy in an appropriate speech, to which His Highness replied in Arabic, and the red ribbon of the Order was placed over the right shoulder and the ceremony concluded. Then followed a grand review of 15,000 troops, the curious being much amused at the performances of the dromedary corps in their Bedouin dress—contrasting in aspect and colour with lancers and regulars, who wore red and blue—and in their wild Arab cry chanted or sung in chorus, reminding the observer of the romantic Oriental story common to tradition.

Whilst in Egypt the Queen's Envoy accepted M. Charles de Lesseps' invitation to inspect the works of the Suez Canal, and accordingly a semi-state visit followed, at which all who shared therein expressed their approval as they saw the amazing work so rapidly nearing its completion.

The visit of the Sultan of Turkey to this country in 1867 and that of the Viceroy of Egypt are fresh in the general memory. Ismail Pasha followed the Sultan at a day's interval, and arrived at Dover on Saturday, July 6th, under the ordinary circumstances of courtly etiquette, proceeding forthwith to London as the guest of the Earl of Dudley in Park Lane. His Highness had a hearty and honourable reception, the Queen having placed General Seymour, her Equerry, at his service, and a squadron of hussars attended the state carriages from Charing Cross to Hyde Park. The Opera, the Zoological Gardens, and many visits duly honoured, on Monday he went to Windsor Castle, attended by a numerous suite and a guard of Scots Fusiliers, and was introduced to the Queen by Lord Stanley (now Earl Derby). On the following day he drove through the forest, and then visited all parts of the establishment. After lunch he went to Eton and received a welcome from the boys, returning to London in the evening. Then followed the usual round—Holland House, the Prince of Wales, and many royal and distinguished visitors, and a magnificent entertainment at the Mansion House, where the Archbishop of Canterbury, Bishop Wilberforce, the Prince of Wales, and the Duke of Cambridge attended with many others to do him honour. "So arrived the successor of the Ptolemies, of the Pharaohs, and of the older dynasties immortalized in colossal porphyry and in figures covered with hieroglyphics. He came, still the Lord of the Nile, still holding some millions in bondage, and able to set them to hard task-work." The Chancellor of the Exchequer (Mr. Disraeli) in happy terms followed the Duke of Cambridge, who had delineated the enlightened character and policy of the august visitor, who replied in Turkish and justified the complimentary observations which had been made. A visit to the Crystal Palace, where by good fortune was an exhibition of agricultural machinery which much interested the Viceroy, occurred on the following day; and, finally, the freedom of the City was presented in the ancient and honoured form, inclosed in the usual gold box, by a deputation of city officers to Dudley House. This gave him the opportunity of acknowledging the welcome he had received from all classes in the country, and engaging himself to encourage and foster commercial intercourse with the City, because it was on commerce that Egypt would depend for prosperity. He had experienced the greatest pleasure in giving a hearty reception to all Englishmen who had visited his dominions, and invited the Mayor or any of the Corporation to allow him to show his sense of the hospitality he had been honoured with by a visit to Egypt, closing his reply with a grateful word for the kindly interest they had shown in the prosperity of his country and his own happiness.

At the Paris International Exhibition of 1867 it will be remembered the most attractive feature consisted in the construction of dwellings, a counterpart of those in the several countries, and in the engagement of natives, or persons dressed as such. The Viceroy entered into the spirit of this novelty by contributing a reproduction of his palace in which he intended to reside when visiting Paris in the summer. Over its entrance was inscribed a sentence often used in the East for that purpose, "O Thou who openest the doors! open unto us the door of Good." The principal apartment was a copy of the chamber in which he was born. The furniture, the hangings, the carving and painting of the ceiling, the marble floor and central fountain, and terraces on to the garden made up a faithful image of existing Oriental luxury. Around this apartment, lighted by a fine dome and large balconied windows, were four cabinets, where he might go to work or rest; all the work of these rooms had been executed at Cairo by Arab artists.

The most costly work of the entire Exhibition was the model of the ancient Egyptian temple which the Viceroy erected in the Park and decorated in the most gorgeous manner, the walls being covered with appropriate ornaments in gold and colours, and with many groups of figures showing the state of navigation and agriculture in the Nile district at the period before Pharaoh. He came to Paris previous to visiting London, and stayed about ten days, returning thither after his stay here, and inspected the Exhibition more leisurely.

H.R.H. the Prince and Princess of Wales visited the Continent in Nov. 1868, for an extended tour. After they had been to Paris, Copenhagen, Berlin, and Vienna, they proceeded to Cairo in Feb. 1869, where they were received by the Khedive with the utmost regality. The Viceroy and the Prince went across to Suez in a half-private manner to make some general examination of the works, and the former to open one of the sluices, leaving the royal visit to the 24th March, when he did not accompany the Prince and Princess, but left them to use his pavilion, yacht, and whatever besides they might desire or find convenient.

The visit of the Prince formed a tie which he often refers to in public addresses in order to express his esteem for his royal friend, the ruler of Egypt. He had been up the Nile with Said Pasha, in 1862, before his marriage, but on this occasion the programme had to be extended. After leaving Trieste, the visitors arrived at Alexandria amid the due formalities, and proceeded to a new palace which the Khedive had been erecting for some time, and had set apart for his guests. The Viceroy, having handed the Prince and Princess into their appointed carriage, himself entered, taking the front seat, an act of courtesy that exceeded the ordinary custom; he accompanied them to the palace and then left. The new edifice had been sumptuously decorated, and furnished with huge mirrors and chandeliers in the saloons, and with four-post silver bedsteads in the sleeping chamber. In the evening he met them at the theatre, and on the next day showed them the departure of pilgrims to Mecca.

The river-barge fitted up for the excursion had been named

Skandria, or Alexandra, in compliment to the Princess, and its interior formed a suite of rooms that were elegant private apartments. Preceding it a steam-tug took it in tow, and contained the staff; and a third steamer carried the cuisine; this order relieved the travellers from all the discommoding effects of steamboat travelling, as the barge itself had no machinery on board. The divans were covered with blue damask, and a piano gave the whole a drawing-room effect. Five other steamers followed for the distinguished companions, such as the Duke of Sutherland and the Pasha in charge of the party.

When the excursion ended the Viceroy had prepared a ball at Cairo on the 4th of March, and for another three weeks did all that the most exquisite taste, politeness, and cordiality could for the never-to-be-forgotten visit of the royal guests.

But the grand event of the Viceroy's life had yet to take place. From Tuesday, the 16th Nov., to the 20th, his hospitality provided a magnificent entertainment in commemoration of the opening of the Suez Canal, when the Empress of the French, the Emperor of Austria, the Crown Prince of Prussia, and many others, specially invited, assembled, to be conducted by the Khedive and M. Lesseps in a procession of steam ships from sea to sea, followed by vessels of almost every European nation.

The arrival of their Majesties and Royal Highnesses at Port Said on the Tuesday morning formed the first incident of the proceedings. The Viceroy had come to meet them by canal from Ismailia, having left the Empress at Cairo, whither she had returned from a trip up the Nile and a nocturnal expedition to see the Pyramids illuminated with the magnesium light. The Emperor of Austria had been cruising along the shores of Palestine. The Empress took ship at Alexandria in the French yacht, "The Aigle." In front of Port Said were two large Austrian ironclads, which were suddenly covered with gay flags to the masthead. Lying off were five ironclads of the British fleet; beyond lay a despatch-boat and a small Russian sloop of war, and about the entrance some Italian steamers clustered; and by the breakwater a perfect forest of masts of all nations except America. The French Imperial yacht's approach was the signal for manning the yards of the fleet and the firing of a grand salute. Steaming past the other vessels, the "Aigle" entered the mouth of the basin, slowly approaching the massed fleet lying outside, every vessel manned and decorated with flags and the merchantmen crowded with passengers, and a cheer, long, loud, and deep, broke out from the men of all nations and languages in a most exciting scene, and for an hour there followed a deafening round of complimentary exchange of salutes.

The next act consisted in a benedictory service in which Mohammedan, Greek Catholic, Coptic, and Roman Catholic joined for once in a common prayer for the success of the undertaking; and a most imposing spectacle it was, as fitting galleries had been prepared and ornamented to produce, when filled, the grandest effect. The distance from the landing-place to the pavilion—half a mile—was lined with Egyptian infantry, between whose ranks the illustrious personages passed to their places, the guns firing and the bands playing. First came the heir apparent of Egypt with the Princess of Holland; the Empress of the French leaning on the arm of the Emperor of Austria, and the Khedive and the Crown Prince of Prussia on either side, following on. The Grand Duke Michael of Russia and the Prince of Holland accompanied them, and a brilliant staff of officers of each nation, all in uniform and decoration, completed the procession. Entering the pavilion, the Empress took the central seat with the Emperor of Austria on the one side and the Khedive on the other, Louis of Hesse and Oscar of Sweden, with ambassadors, grouping around according to their degree; and engineers, and representatives of commerce, and distinguished men whose vocation was maritime, crowded the platforms, or were among the multitude upon the sand. The chief ecclesiastic of the Mohammedan faith, a white-bearded and venerable man, read from his scroll a prayer to Allah to bestow a blessing upon the multitude and the enterprise now to be devoted to the service of mankind. He having concluded, the Archbishop of Jerusalem ascended the steps of the high altar in a Christian kiosque, and with his priests said mass; then came a fine-looking priest, Bauer, the Empress's confessor, and he delivered an elegant discourse or eulogy on all the persons and objects around them, comparing Lesseps to Columbus. After some scattering of flowers, and other pleasantries, the company withdrew to their respective yachts.

In the evening a splendid display of fireworks and a general illumination made Port Said gay. A double line of red flagstaffs down each street, different-coloured banners, lines of coloured lanterns, and the crescent everywhere formed a quaint and brilliant spectacle. As evening drew on, and objects faded from view, strings of lanterns, running from mast to mast and down the rigging, everywhere appeared; and the men-of-war had lights in the port-holes. The shore was as gay as the sea, the tents of the troops being dotted with lanterns: on the breakwater and piers tar-barrels blazed at short intervals, while over all from the top of the lighthouse, 180 feet high, there poured down a flood of electric light, now and again dissolving and brightening with splendid effect.

Wednesday morning—the day of days—was anxiously waited for; and at eight o'clock the Empress's yacht started, followed by thirty-five official ships, and these by as many miscellaneous, down to Ismailia, and, after a twelve hours' passage, assembled in Lake Tesmah, amid the cheering of a motley crowd of wondering spectators and the roar of cannon from the batteries, succeeded by the shrill rattle of platoon firing and the glory of the setting sun. On the following morning, the Khedive conducted his royal visitors, in four-horse carriages, and under triumphal arches, to a new palace built for the occasion, all the way being guarded by cavalry half on white and the other on bay horses. At night he entertained his august friends with a sumptuous ball, which was attended by several thousands of people. On the following day the voyage was resumed to the town of Suez, and festivities again testified the public congratulation.

But these events displeased the Sultan. He did not conceal his jealousy at the attention shown to his inferior by the European courts and people, not being able to appreciate the western preference for an active, enterprising ruler to the greater monarch whose chief charm was outrageous display and self-regard. He took umbrage also at the Viceroy taking upon himself to issue invitations to the foreign monarchs to be present at the opening of the Canal, as an infringement of his prerogative, and also because he did not conceal his impatience at the dilatory and unstatesmanlike conduct of the Sultan's government, but showed a spirit of independence. This evoked a "statement of grievances." The Khedive replied, defending himself against a charge of insubordination, and enumerating the services he had rendered in suppressing the Candian rebellion at the expense of Egypt, although Egypt had really nothing to do with the quarrel. He then referred to the extension of his power conceded in 1867, by which his dynasty was acknowledged, and he became more independent and took the title of Khedive, and averred that, as he had met the European princes, he could but return their invitation, and that ought not to be regarded as violating his due obedience, but on the contrary should indicate his desire to add lustre to the kingdom. He then vindicated the mission of Nubar Pasha in Europe, on the ground that the development of Egypt, and its position as the highway to the East demanded the service of an ambassador in Europe in order to avoid disputes and litigations arising from the new interests created. Passing on to the Sultan's complaint of his extravagance and the augmentation of taxes, he begged His Majesty to compare the state of the country now with its condition at his accession, and assured him that he had laboured incessantly and successfully in furthering the happiness and prosperity of the people, and in strengthening the security of property and life. He pointed out that Egypt has had since 1866 representative institutions, and that the people's delegates meet for two months in every year for deliberation, for controlling expenditure and overlooking the general administration, and has the right of fixing the Budget and augmenting or decreasing the taxes. At the beginning of his rule schools had been suppressed, and science and civilization brought to a stand, but he referred to the new institutions, so numerous and various and well organized; to the new plan of sending the youth into Europe for education that should perfect them in science and letters, in arts and industry, and alleged that these efforts were already fruitful.[1]

He reviewed the condition of agriculture in the same way, showing what misery had been caused by murrain and inundation destroying crops and cultivation, and how by lavish expenditure and sacrifices those evils had become extinct; that from those great works of irrigation and transport thousands of acres of land had been redeemed from waste, and that by developing financial institutions throughout the land he had tempted foreigners to come and settle in the country in safety, to the vast advantage of Egyptian relations in the commerce of the world.

Boldly proceeding, he declared that, notwithstanding the immense works he had done in railways, canals, constructing ports, improving harbours, and providing warehouses, every man had his salary every month, and the debt had been reduced, so that any complaint of the management could not truly be made. He then took up the Sultan's complaint that he had been purchasing firearms and ships, to which he answered that he had discarded the old useless forms and adopted the modern effective ones, and all this through the Assembly of Delegates, who, he reminded him, had voted the money also.

These two documents carry their own reflections. For the

[1] His son, Prince Hassan, of Christ Church, Oxford, received the Hon. D.C.L. degree on the 13th June, 1872.

sake of peace the Khedive met the demands of the Pasha as to war-ships and other matters, and the two men are now each working out a very natural result from evident causes, maintaining tolerable relations with each other; and once (1870), when the Khedive went to Constantinople on a state visit to the Sultan, that sovereign gave him a cordial reception, and the city and the waters of the Bosphorus were illuminated.

The relations, nevertheless, were not altogether cordial. How could they be between men of such opposite temperament? The irritation ended by a firman, dated 8th June, 1873, granted by the Sultan to the Khedive, sanctioning the full autonomy of Egypt, and enacting the law of primogeniture in favour of Ismail Pasha's family.

Last year difficulties arose about the tonnage dues on the Canal; Lesseps insisting on a higher rate than that fixed by the Constantinople Commission, and threatening to close the Canal. That could not have been a sincere threat, and it proved to be a mistake. It could never be suffered that any individual, however great and distinguished, should exert his self-will to the public hurt. Her Majesty's Government remonstrated all round, for all were losing temper and patience, and the obnoxious demand was withdrawn.

The Nile overflowed in September, 1874, and the Khedive made prodigious efforts to fight the unruly waters, in which he was successful; and the European colony of Alexandria addressed him on December 8th, in the following terms, with which we must close this notice of one whose career will brighten as it goes, notwithstanding the difficulties which now beset him in reference to the Slave system, the Abyssinian difficulty, and the trouble about Zanzibar,—points not within the scope of discussion here :—

"To His Highness Ismail Pasha, Khedive of Egypt—Monseigneur—The country has witnessed with profound emotion the struggle your Highness has lately sustained with the impetuous Nile, whose waters, having reached a height heretofore unknown, threatened to invade Egypt. The works commanded by your Highness and your constant vigilance have overcome the great river that was about to invade these rich plains, and success has crowned the noble efforts of your powerful hand, which, by God's help, has been able so energetically to curb that stream.

"The European colony of Alexandria desires to testify its profound sentiment by means of a memorial that shall proclaim to future ages what a prince can accomplish who knows how to combine political wisdom with all the talents and virtues of an able administrator," &c., &c.

In reply, the Khedive said it was a real happiness to him that Heaven had given him the power of being useful to the country, and he would do all he could to insure the prosperity of Egypt and the European colony. He spoke of the annexation of Darfour to the Egyptian dominions, which brought an increase to the population of five millions. He hoped that in five or six years Darfour and Central Africa would be united with Egypt by a line of railway, the cost of which would be defrayed by the resources of Darfour and Central Africa alone, without any recourse to foreign capital.

Enough has been laid before our readers to warrant the remark with which we set out, that under this man the land of Egypt has awakened from the dream of ages, and that her future career bids fair to revive in modern forms her ancient renown.

W. S. C.

QUADRUPLEX TELEGRAPHY.

By S. M. Plush.

THERE exists some doubt as to the origin of duplex telegraphy; some refer it to Dr. Gintl, in 1853. It is certain, however, that experiments were made by the Electric Telegraph Company of England, in 1853; by Gintl, Siemens, and Frischen, of Russia, about the same time; by De Sauty, in England, in 1855; and by the Magnetic Telegraph Company, between London and Birmingham, in 1856; but owing to various difficulties, not then to be overcome, the system was for the time abandoned, no advantageous results over the single method having been obtained.

It remained for J. B. Stearns, of Boston, in 1868, to make the duplex of practical importance, and he undoubtedly stands in the same relation to the duplex as Morse does to the single system.

While neither Morse nor Stearns perhaps were entitled to the credit of the discovery of the principles upon which their inventions were based, nor the fundamental laws by which they were controlled, still by a knowledge of these, and a proper combination and application of various mechanical appliances, some new, some old, instantaneous communication became a reality, whereas it was before a dream; and things that were seemingly impossible were no longer so, as in double transmission on one wire. We cannot consistently withhold the credit from these men whose efforts have converted our scientific toys into instruments of usefulness, whereby our commerce and finance are enriched, and social pleasures enhanced *two*, yes, *fourfold*.

In 1872, the American Institute of New York, after a most careful and exhaustive examination, awarded the Great Medal of Honour to Joseph B. Stearns for the invention of the Duplex Telegraph, being the second of this class of medals issued since its foundation; the conditions upon which they were awarded being such as to exclude all inventions and improvements except those of paramount importance.

The Differential Duplex, as perfected by Stearns in 1868, consists of an improved transmitter or key, with double contact points, and, more recently, condensers, whereby the difficulties attending long circuits were entirely overcome, and the working capacity doubled. The helix is composed of two wires of equal lengths and resistances, the outer end of one and the inner end of the other being brought in direct contact with the key; one of the distant ends of these wires is connected to the earth through coils of the same resistance as the line. The transmitter is an ordinary Morse key, having two contacts, one with the battery when the lever is depressed, and the other with the earth when elevated, one contact invariably being made by spring connection *before* the other is broken. Thus the line is always to earth, either through the battery or direct. By depressing the key at one station, contact is made with the battery; the current, dividing equally, passes through each coil of the relay at such station, in opposite directions. The magnetic power of each being equal, and of opposite polarity, produces no effect on the armature, while a current sent from the distant station passes through one coil only, and affects the armature corresponding to the signals sent. When both stations are sending, double the quantity of electricity which passes through the resistance coils is passing through the line coil at either end. The cores of both relays therefore become magnetized by this difference, and signals are recorded simultaneously at both stations.

When this system of duplex was first tested on long lines, a very serious difficulty presented itself, caused by the discharge of return currents through the relay, being proportionate in volume to the static capacity of the line. Electricity invariably follows the channel of least resistance to earth, while in a long and well-insulated conductor of large metal cross-section electricity will flow through to the distant end, and to ground, so long as battery power is maintained; if ground contact be suddenly substituted for this, part of the charge left in the conductor at that instant will return to the ground in preference to overcoming the resistance intervening between it and the distant ground.

The use of the condenser is to obviate this, by furnishing an additional static capacity equal to that of the line; and by this means circuits of several hundreds of miles can be successfully worked.

A condenser is an apparatus by means of which a large quantity of electricity can be gathered on a small surface. Its form may be greatly varied; but the essential points consist of two good conducting surfaces, separated from each other by a non-conducting surface. The charge depends on the size of the surfaces of the non-conductor placed between the condenser plates; on the tension of the electricity which furnishes the charge; on the distance between the metallic plates, and on their size. They are usually constructed of thin sheets of paper, saturated with paraffin, and covered on both sides within a short distance from the edge with tinfoil; they are then laid singly, one upon the other, like the pages of a book; the tinfoil plates being connected together in two series, upper and under. In this manner two separate rows of metallic plates are formed, separated by the paraffined paper, and presenting a large surface in a small space.

A rheostat is a combination of measured or known resistances, so arranged that any desired amount can be put in circuit or removed at pleasure; the ends of the several resistances are connected to brass discs, which can be connected or disconnected by simply removing the metallic pins that connect these discs together. When the pins are in, an electric connection is formed from one disc to another; when they are out, this connection is broken, and the current obliged to pass through that portion of resistance corresponding to the discs. The resistance coils, as a rule, are wound with German silver wire; the specific resistance of which metal is but slightly affected by temperature.

Rheostats, being composed of fine wire of a highly resisting material, have not the static or charge capacity of a long line; the metal of the one weighing a few ounces only, that of the other many tons of good conducting substance. No return charge, therefore, is felt from the rheostat. By connecting to the rheostat a condenser of equal static capacity to that of the line, a charge will be returned from it, simultaneously with that from the line, one balancing the other, and preventing any tendency to magnetize the cores of the relay. This system of duplex can be worked equally well with either pole of the battery to the line. When both stations use currents of the same polarity, they oppose each other midway, allowing the currents in the rheostat coils of the relays at the sending stations to influence the relays, the same as if both currents combined on the line.

The bridge duplex (Stearns' more recent invention, on which the quadruplex is based) is founded on the Wheatstone Bridge or balance principle. This method consists in the combination of the receiving instrument or relay with resistance coils, so that, when a current is transmitted from one station, it does not pass through the receiving instrument at that station, but directly to the line, the instrument at this station responding only to the currents sent from the distant station. Any kind of receiving instruments may be used in lieu of the relay.

When a current is divided between two circuits which are connected by a cross-wire or bridge, no current will pass through the bridge, provided the resistance of the opposite circuits on each side of the bridge are equal, or are in the same ratio to each other.

Fig. 1 will materially assist in comprehending the principle upon which this method is based. When the key (K) is closed, the current thus sent to the line will divide at H, one part flowing through the line, via A, the other through the resistance coils (R) to earth (g) via B, in the proportion of their respective conductivities. (Conductivity being the reciprocal of resistance.) Now, if the combined resistance of A and L be equal to that of B and R, no current will pass through the bridge wire, or, if the resistance of the branch A bears the same proportion to that of L that B does to R, then no current will pass through the bridge. For example, suppose the resistance of A to be 500 ohms, L 2,000, B 250, and R 1,000, then no current would pass through the cross-wire, because the two circuits A and B are in the same proportion to each other as L is to R. When the current reaches the distant station it divides at F; one portion going to earth, via A and K, and the other to earth, via rheostat R, in the inverse ratio of their respective resistances. The instrument, being placed between the points F G, is influenced by that portion, and thus records the signals. When, however, a current from the distant station is put on the line, the quantity of electricity on the line is doubled; but only the part supplied from either end finds its dividing point at the distant point F, a portion passing through each bridge, thus effecting the relays, and recording the signals.

Figs. 2 and 3 represent the rheostat and transmitting sounder in use in the bridge duplex. Fig. 2 contains the condenser plate, adjustable resistances and binding screws, for connecting the apparatus. The central disc is connected to the condenser by binding screw C; the inner circle of discs is connected to earth by binding screw E, and is attached to resistance coils of 1,000, 2,000 and 4,000 ohms each, corresponding with rheostat R in fig. 1. The outer circle of discs corresponds with rheostats A and B in fig. 1, and is connected with resistance coils of 40 ohms each, terminating respectively with resistances of 400 and 600 ohms. The outer circular ring corresponds to the point H in fig. 1, and is attached to binding screw T, which is connected with binding screw 2 in fig. 3, and corresponds with 1 in fig. 1.

The line wire, and one side of the relay, is connected with binding screw L, and the other side of the relay with binding screw R. The two sides of the bridge can be varied at pleasure by the insertion of a plug at different points in the series of holes, between the circular ring and outer circle of discs; and the third side of the bridge can be lengthened or shortened as desired, by the insertion of plugs in the holes between the inner circle of discs.

In fig. 3, L and L are binding screws, for connection with a local battery and key, by which the transmitter is manipulated. Binding screw 1 is connected to the earth, and binding screw 3 with one pole of the main battery. Between 1 and the earth, and between 3 and the battery, are inserted small coils of resistance, for the purpose of maintaining a uniform resistance in both branches, and preventing the battery from being short circuited in changing from the back to the front contact.

Binding screw 2 is connected with binding screw T of fig. 2. L M are the local magnet coils; A, a set screw and contact point connected with one pole of the main battery, the other pole of the battery being connected to earth. The earth is connected with the lever D; B is a contact spring, insulated at C, and connected as before described with the bridge ring terminal, by binding screw T.

When the key of the local circuit is depressed, the armature is drawn down at L M, which makes the contact between the spring and contact screw A complete, and breaks it with lever D. The operation, being otherwise substantially the same as before described, need not be further explained.

The transmission of four messages over one wire at the same time, two in the one direction and two in the opposite, without confusion or in any manner interfering one with the other, necessarily required for its development a thorough understanding of the principles by which the duplex is governed. Electricians were then ready for the next great achievement in paradoxical inventions.

The quadruplex, which, as before stated, is founded on the bridge duplex, was invented by Prescott and Edison, in 1874.

[Other methods of the quadruplex have been brought to notice: that of M. Meyer, of the French Telegraph Administration, transmitting four messages over one wire in the same direction, and that of Dr. Nicholson of Ohio, based on the differential principle. But, as they have not yet proved of practical value, a description would be of slight interest here.]

According to their system, it is necessary at each station to have two transmitters and two receiving instruments, so arranged, that when one transmitter is closed the corresponding receiving instrument only at the other station will respond. When the other transmitter is closed its corresponding receiving instrument responds; and when both transmitters are closed at the same time both receiving instruments respond; the receiving instruments at the sending station remaining unaffected by these operations, and ready to be influenced by similar manipulations at the other end. In order to accomplish this, two relays are placed in the bridge wire; one a common relay of short cores, low resistance and counteracting spring, capable of being affected only by strong currents; the other a Siemens' polarized relay of high resistance, and sensitive to feeble currents. The polarized relay is arranged with a closed stop in front, and an open stop back, in such a manner as to allow the tongue of the armature to make contact with one or the other, as the armature may be affected by the polarity of the current passing through the coils.

The common relay is provided with similar stops, having its closed stop on the spring side. Each relay is provided with two local batteries, one of which is connected through the relay points and the coils of a local relay, which local relay is provided with contact points, so arranged as to close with the open circuit or upward movement of the armature; this, of course, reverses the signals. The other local battery is connected through these points and the coils of the local sounder, which again reverses the signals, making them normal. (Fig. 4.)

One of the transmitters is a pole changer, having one spring connected to the line, and the other to the ground. The smaller portion of main battery is connected crosswise with the contacts of each spring, through the spring and lever of the single transmitter, which has an additional section of battery inserted between the lever and its closing contact points. The movements of the double transmitter entirely determine the polarity of the current sent to line. The other transmitter merely cuts in or out of circuit, an increased portion of battery—sufficient to close the common relay at the distant end.

By reference to fig. 4 (which is an exact representation of the quadruplex, as in use by the Western Union Telegraph Company), it will be seen that the main battery is divided at X (the division usually being as one to three); the smaller portion, Y, being connected to the double transmitter or pole changer, D; the larger portion, Z, to the single transmitter, S. Both transmitters are placed in a local circuit (L B) and manipulated by an ordinary Morse key (K). When both transmitters are open the smaller portion of the battery will be presented to the line, through the double transmitter (D), its currents will divide between the sides of the bridge at the point H, one portion passing through A, over the line, the other through B, via R (rheostat), to ground. That portion passing over the line will divide at the distant point, F, one portion passing through A to key and earth, the other through the bridge wire and relays to earth. This current will influence the armature of the polarized relay (P), causing it to rest on the front or closed stop, but is not of sufficient strength to affect the common relay (O).

This same portion of battery is reversed by closing the double transmitter, which will reverse the movements of the polarized relay, causing its armature to rest on the back or open stop, and the local sounder, L S, responds. Still the common relay, O, is not visibly affected, though both currents have traversed its coils; but when the single transmitter, S, is closed, the full force of all the batteries is brought into action; that portion passing through the relays is now sufficiently powerful to attract the

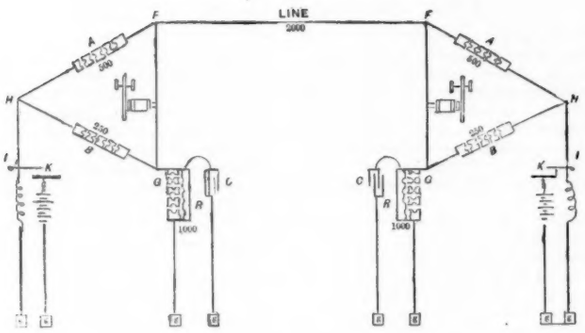


Fig. 1.

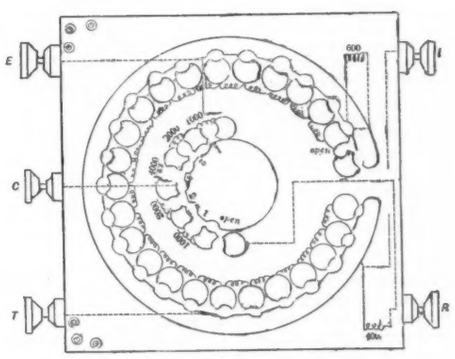


Fig. 2.

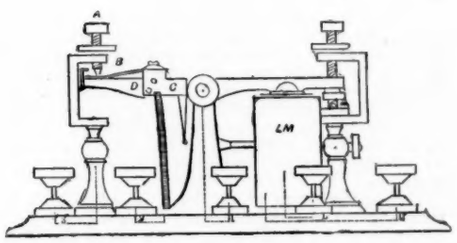


Fig. 3.

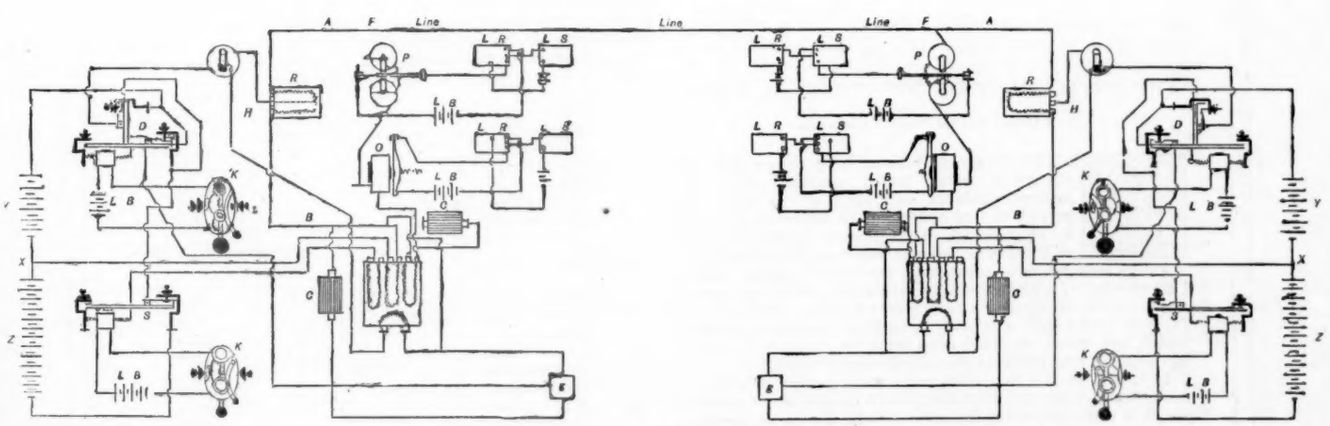


Fig. 4.

QUADRUPLEX TELEGRAPHY.

armature of the common relay, O, and the corresponding sounder speaks. The single transmitter cannot record a signal on the polarized relay when the double transmitter is open, because the current is of the wrong polarity: as before stated, the double transmitter determines the polarity of the current sent to line; if open, one pole of the battery is presented; if closed, the other; the single transmitter merely increases or diminishes the amount. The same results are obtained at the home end by similar manipulations at the other.

For reasons already explained, the bridge wire is provided with a condenser, C, charged by the relay currents. When the current is withdrawn from the relays, the condenser discharges before a reversed current reaches them, thereby prolonging the signals and maintaining a magnetic equilibrium of the cores.

The strength of current passing through the bridge relays can be increased or lessened at pleasure, it not being necessary that both sides of the bridge shall be equal to each other, but that they should be in the same ratio, as explained when treating of the duplex.

The complexity of the apparatus, and the accurate adjustments necessary to utilize its full working capacity, require great skill and careful management. The officers of the Western Union Telegraph Company have proved themselves entirely *au fait*, and the quadruplex is now in daily successful use between the more important points of telegraphic communication in the United States; the distant points working direct with each other through intermediate repeaters.

For example, the circuit from New York to Chicago (nearly one thousand miles) is worked with repeaters at Buffalo. When desired, this circuit can be divided at Buffalo (by switches with which each complete set of instruments is provided) in such a manner as to allow New York to send to and receive from Chicago, and Buffalo to send to, and receive from both Chicago and New York; thus giving the capacity of one wire to and from each of the points named.

When it is considered that by this system—in addition to quadrupling the capacity of a wire, enabling communication direct with stations far distant, whose amount of business would not warrant the maintenance of a wire for that purpose alone, and allowing half the capacity of the wire to be used in sections if desired, for the benefit of intermediate stations—there is saved the investment for the cost of additional wires, and the liabilities to troubles, where many wires are crowded upon one line of poles, an indefinite idea may be formed of the value of this wonderful invention.

The perfection to which the telegraph has so rapidly approached has virtually annihilated time and distance, is aiding the enforcement of the laws, and bringing the nations of the earth in more harmonious relationship—making all mankind friends, and the bond of union which civilization is each day riveting a safeguard against future discord.

East, west, north, and south are all within the speedy reach of the lightning messenger, through whose invisible manœuvres the untiring signals of the telegraph breathe the wishes of the world, news of national or financial import, and tidings of joy or grief, with unerring promptness.

The news of yesterday in the old world becomes the theme of conversation to-day in the new; thus completing the triumph of science, and the testimony of success to energy and perseverance.

THE EMPLOYMENT OF CONDENSATION WATER FOR FEEDING BOILERS.

NUMEROUS observations have shown that condensation water which contains fatty substances produces very bad effects when employed to feed boilers. The following statement by Herr Stingl, of the Higher Technical School at Vienna, removes all doubt on the subject:—

When, besides fatty substances, the water contains salts of lime or magnesia, and especially carbunates, which can be only very partially eliminated by a previous heating to 60° or 70° C. (140° or 158° Fahr.), a calcareous soap is formed in the boiler, which, by keeping the plates from being moistened by the water, at the same time prevents the adhesion of incrustation.

It is well known that calcareous soap, heated to a certain temperature, is decomposed into a free fatty acid, and a residuum which is destroyed under the influence of a higher temperature. The fatty acid in its turn is decomposed, and the carbonized substances are set at liberty. As in boilers the heat is strong enough to favour the decomposition of calcareous deposits into a fatty acid, which is most frequently oleic acid, and a calcareous basic soap, it is easy to understand why incrustations of this nature attack the boiler plates and reveal traces of fatty acid when they are decomposed by hydrochloric acid, and the organic precipitate is shaken with ether. These deposits are generally brown-coloured, which arises partly from a considerable quantity of oxide of iron, and partly from the decomposed fatty acid.

Supposing the greasy water poor in salts of lime or magnesia, which may be known when the precipitates caused by hydrochloric acid are insignificant, it nevertheless acts with destructive effect on the boiler plates. We know that, in the phenomenon of saponification under a high pressure, a relatively small quantity of lime is sufficient to induce the separation of a neutral grease into free fatty acid and glycerine. It is true this takes place under pressures equal to ten atmospheres, but it admits of no doubt that, for quantities of grease so small and divided as those which exist in condensation water, the neutral grease must be decomposed into fatty acid and glycerine under a feeble pressure, considering the continuance of the action.

Water from a machine-maker's at Leobensdorff, though soft (showing only 6° of hardness), and depositing very little, had nevertheless in three years completely destroyed a new boiler which was always kept very clean and not subjected to excessive work. This water had a milky appearance, and contained about ·2,120 parts of fatty matter per litre (nearly a quart), a very high proportion, which ought rarely to be met with in water of this kind. The fatty substance was composed of a fixed part and oleic acid. The incrustation was in too small a quantity and too dusty to be analyzed.

Some years ago the cistern of a gasometer at some gasworks in the suburbs of Vienna was filled with condensation water from the workshops of the railway. At the end of four years the gasometer was found completely rusted to the height of the hydraulic joint, while gasometers last twenty or thirty years when they are filled with ordinary water. This destructive effect is owing to the presence of free fatty acid in the water. The effect of oleic acid on oil pumps is well known.

It cannot be reasonably contended, in the face of these experiments, that the presence of grease in boilers is no disadvantage. Herr Stingl does not mean to say that a boiler must inevitably explode when it is fed with greasy water, but he feels bound to insist on the fact that the iron of the boiler is gradually dissolved, and disappears in the form of oxide in the incrustation, in other words, the destruction is slow but certain.

In 1873 Herr Stingl had occasion to examine the feed-water at a jute factory at Florisdorf, near Vienna. They used the condensation water of two engines, one of 100 horse power, and the other 300. At the end of two or three weeks of this use, the steel-plate boilers on the Cornonailles principle showed considerable leaks; in spite of cleaning every week, some of the plates gave way, and the works had to be stopped. On examination it was found that the plates of the heating tubes were covered, especially in the upper part, with incrustation, which in eight or ten days had reached the thickness of 8 to 11 millimetres (·312 to ·429 in.), and prevented the contact of the water. The water had a thick opaline appearance, owing to the presence of particles of grease loosely held together, and capable of being isolated by ether. (By shaking water of this nature with ether in a glass tube, it becomes clear after its separation from the ether. This simple operation is sufficient in many cases as a qualitative analysis.) On analyzing this water, which came out of the condenser at a temperature of 40° to 50° C. (104° to 112° Fahr.), Herr Stingl found, out of 10,000 parts,—

	Parts
Lime	·8631
Magnesia	·3334
Sulphuric acid	·1858
Chlorine	·0816
Silica	·0023
Oxide of iron and alumina	·0241
Alkalies (soda)	·0653
Loss by combustion	·4138

corresponding to:—

	Parts
Carbonate of lime	1·3091
Carbonate of magnesia	·6930
Gypsum	·3158
Chloride of magnesium	·0134
Common salt	·1200
Oxide of iron and alumina	·0241
Silica	·0023
Organic substances	·4138
	2·8915

The total of the substances found directly was 2·3561 out of 10,000 parts.

The incrustation arising from this water had a deep brown-grey colour, and was of soft consistence. On being reduced to powder, it was with difficulty moistened by water. Treated with hydrochloric acid, it excited a strong effervescence. On the surface of the acid saline solution was collected a brown, oily mass, which, on being shaken with ether, gave 5·19 per cent. of brown oil.

The residuum, insoluble in hydrochloric acid, and composed of grease and a flaky substance, was washed with ether to separate the grease, then dried at a temperature of 100° C. (212° Fahr.), weighed and analyzed. The total mass gave :—

Substances insoluble in Hydrochloric Acid.

	Per cent.
Silica	·32
Oxide of iron	3·73
Gypsum	3·13
Organic substances	8·46
Grease	5·19

Substances soluble in Hydrochloric Acid.

	Per cent.
Gypsum	30·24
Magnesia	8·07
Sulphuric acid	2·08
Carbonic acid	28·54
Oxide of iron	9·02
Alumina	·31
Silica	·02

which corresponds to—

	Per cent.
Carbonate of lime	51·42
Carbonate of magnesia	11·30
Oxhydrate of magnesia	3·90
Gypsum	6·63
Oxide of iron	12·75
Alumina	·31
Silica	·34
Fatty acid	5·19
Combustible substances	8·46
	100·30

It follows, from these analyses, that the water must deposit considerable incrustation, on account of the great proportion of carbonate of lime it contains, and that the fatty acid must have a disintegrating effect on the boiler plate. Bearing in mind, moreover, that steel plates are more sensitive to these high temperatures than ordinary plates, we can easily explain the rapid deterioration mentioned above. In the space of ten days a mass of nearly 200 kilogrammes (440 lbs.) had been deposited on the upper part of the heating tubes, and thus prevented their contact with the water.

To rid the water in question of its carbonate of magnesia, and remove the grease in suspension, it was mixed with a solution of caustic lime, and filtered in a Bérenger apparatus. The precipitate formed under these circumstances partly includes the particles of grease in suspension, and thus mechanically retains them in the filtering mass : on the other hand, the caustic lime acts on the grease, and gives rise to a calcareous soap. This reaction is favoured by a suitable temperature and the brewing which takes place in the mixer, where the water, before reaching the filter, remains eight or ten minutes in contact with the lime water thrown in. The purified water comes out of the apparatus completely clear. It gives by analysis, out of 1,000 parts,—

	Parts.
Lime	·1884
Magnesia	·2013
Oxide of iron and alumina	traces
Sulphuric acid	·1217
Chlorine	·1500
Silica	traces
Alkalies	·1058
Loss by combustion	·1512

which corresponds to—

	Parts.
Carbonate of lime	·1773
Carbonate of magnesia	·4135
Gypsum	·2068
Chloride of magnesium	·0108
Common salt	·2351
Oxide of iron and alumina	traces
Silica	traces
Organic substances	·1512
Total.—	1·1947

No grease could be discovered in it. By purification the proportion of organic substances was reduced from ·4138 to ·1512 parts. The manager of the establishment has stated that since the introduction of the process the repaired boilers have done duty for three months without interruption, that the deposit in places most exposed to the fire does not reach the thickness of a sheet of paper, and is easy to remove, and that the whole quantity in the boiler does not weigh 3 kilogrammes (6·6 lbs.). This deposit is a brown, friable substance, and on analysis gives :—

Substances insoluble in Hydrochloric Acid.

	Per cent.
Silica	2·04
Sulphuric acid	5·65
Lime	4·01
Oxide of iron	·47
Organic matter	7·35
Grease	traces

Substances soluble in Hydrochloric Acid.

	Per cent.
Lime	13·07
Magnesia	31·65
Sulphuric acid	3·23
Carbonic acid	9·15
Oxide of iron	8·96
Water	12·12

which corresponds to—

	Per cent.
Carbonate of lime	19·41
Carbonate of magnesia	1·16
Oxhydrate of magnesia	45·02
Gypsum	15·09
Oxide of iron	9·43
Silica	2·04
Organic matter (insoluble in ether)	7·35
Grease	traces
Total.—	99·50

Consequently, this incrustation is half composed of oxhydrate of magnesia, which rarely happens with low-pressure boilers, and cannot be injurious there, since the deposit is friable. But for high-pressure boilers the magnesia ought to be eliminated, because salts of magnesia, and particularly the carbonate, form with gypsum very hard incrustation. As lime alone, not used to excess, only partially precipitates magnesia, it is necessary, in the case of high-pressure boilers and water rich in magnesia, to employ for purification a mixture, in suitable proportions, of caustic lime and caustic soda. This mixture also precipitates fatty acids.

The apparatus at work at the jute factory at Florisdorf is worked as follows :— A pump sucks up the condensation water by a system of special pipes, and discharges it into a mixer, where a special pump pours in a sufficient quantity of a pure solution of lime. The lime water is prepared in vats, and brought to reservoirs, whence it is drawn by the pump. After the intimate mixture has taken place, when the reaction is over, the water is conveyed with the precipitate on to the filter, where it is clarified. Thence it flows into a receptacle, where it rests before being sent to the boilers. The use of the apparatus is therefore simple, and its management easy. The water being in the present case poor in gypsum and salts of magnesia, and the boilers working under a pressure of four or five atmospheres, lime alone is sufficient.

When it is required to free water from lime and magnesian salts, as far as possible, recourse must be had to several reagents, and the apparatus hence becomes rather complicated.—*Revue Industrielle, from the German.*

AGRICULTURAL MACHINERY.

THIS month we place before our readers illustrations of a pony gear constructed by Messrs. Cambridge and Parham of Bristol. Every description of agricultural machinery is now so familiar to most persons that very little is left for the journalist to chronicle. At the same time, however, the voice of public opinion, as well as keen competition, being great spurs to progress, it is well to give every publicity to all productions of a useful and practical nature, and machines for the tillage of the soil are as important to the national well-being as are locomotives and telegraphs. The little machine illustrated be-

low is an example of those small gears by which the power of a pony or donkey is utilized in driving chaff cutters, turnip slicers, and other small fry of farm machinery.

The second illustration is one of a clod crusher manufactured by Messrs. Parham. A clod crusher is essentially a machine, the real uses of which can only be understood by practical farmers who have to till farms of heavy clay soils of brick-clay consistency, which in wet weather is so much mortar, and in dry weather is a mass of clods as hard, and a great deal tougher than inferior bricks; and nothing serves to reduce

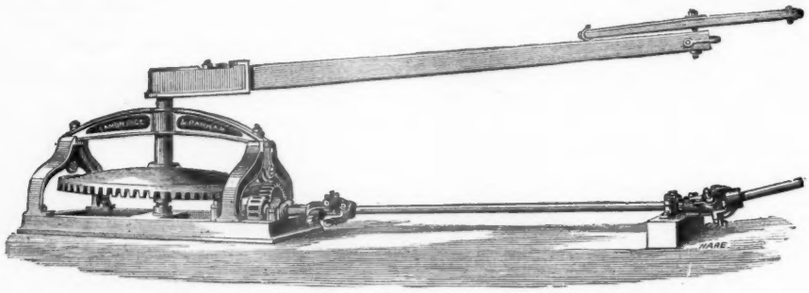


Fig. 1.

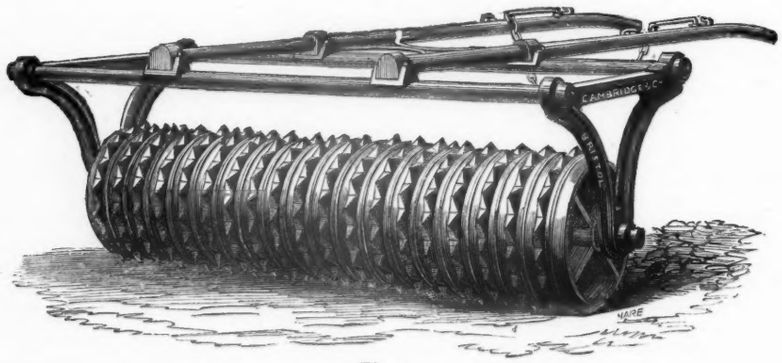


Fig. 2.

these but such a machine as that we illustrate. Consisting of a series of massive rings resembling huge spur rowels, serrated on their edges, and strung on an axle secured to a shaft framing, the entire affair is a massive machine of great weight, and when drawn over a cloddy field, the teeth and edges of the rings cut and rend the clods to a comparatively fine seed bed.

Chemistry applied to the Arts, Manufactures, &c.

ABSTRACTS FROM FOREIGN PERIODICALS, TRANSACTIONS OF SOCIETIES, ETC.

§ 1. *Acids, Alkalies, and Salts.*

SALT production in Portugal.—The salt marshes of Portugal produce a quarter of a million tons of salt annually. The centres of production are Setubal, Lisbon, Aveiro, and Algarve. The arrangement of the marshes is very simple. They cover a vast area, divided into squares separated from each other by paths about a yard wide, and connected with a reservoir which feeds them with sea water. This water evaporates, and deposits its salt without previous concentration or purification. In autumn it is allowed to flow till it covers the marsh to a depth of 20 to 24 inches. In spring the water evaporates, and in the month of June the paths begin to appear above the level of the waters. They then clean the basins, leave them to themselves, and keep on filling them up from time to time with water.

Under the influence of the north-east winds which prevail at that season, the evaporation is very rapid, and at the end of twenty days every basin is covered with a layer of salt almost dry, and about an inch and a half thick. This is the first crop. The salt is gathered, sea water again admitted, and twenty days afterwards there is a second crop. They do not wait till the evaporation is completed, and leave in the basin a layer of mother water, about an inch deep, which covers the salt. If the season is favourable, a third crop may be got; otherwise in September the salt marsh is flooded. *Revue Industrielle, Jan.* 12, 1876.

Sulphate of Magnesia and Cotton.—Sulphate of magnesia is now prepared in large quantities at Stassfurth, in Germany. It is employed in this country to give weak and light cotton fabrics the appearance of strong and good ones. For this purpose they are put into concentrated solutions of sulphate of magnesia, and dried gradually. Of course washing soon brings them to rags, and the loss of weight has been found, by experiment, to be 53 per cent. *Revue Industrielle, Jan.* 12, 1876.

§ 2. *Metallurgy.*

Extraction of Silver contained in Cast-Iron Crucibles.—During the fusion of silver or an alloy of this metal in cast-iron crucibles, a considerable portion of silver penetrates into the substance of the crucible. Cast-iron crucibles may be used ten or fifteen times before being useless. After this they contain an amount of silver that ought not to be wasted. To extract it, the fragments of the broken up crucible are put into a solution of sulphate of copper, in which the iron dissolves and the copper is precipitated. This copper precipitate contains silver, graphite, silicium, and all the insoluble residues. It is treated as argentiferous copper. This method is defective, for the silver which is found at first in 100 kilogrammes of cast iron is afterwards found in 113 kilogrammes of impure copper, so that it has been diluted instead of concentrated.

M. SCHRŒTTER, the Master of the Mint at Vienna, has tried the following method. The fragments of the crucibles are dis-

solved in diluted sulphuric acid without heating. This process is performed in tubs with double bottoms partly open, on which the fragments are placed, that the cast iron may remain in contact with the acid while the concentrated solution of sulphate of iron is falling to the bottom. After ten or fourteen days the acid is saturated, and the sulphate of iron may be made to crystallize. The insoluble residues amount to about 20 per cent. of the weight operated on. They contain all the silver, graphite, oxide of iron, copper, and traces of sulphur and phosphorus. The larger pieces of silver are picked out and the remainder treated with amalgamation. An operation performed at the Mint of Vienna in this way on 345 worn out crucibles, weighing 52,360 kilogrammes, gave 352 kilogrammes of green vitriol of commerce, the residues of the treatment with sulphuric acid weighed 10,472 kilogrammes, and 335 kilogrammes of silver were extracted. Hence the crucibles contained about ·639 per cent. of silver. *Bulletin de la Société Chimique, Dec. 20th*, 1875.

Respective Values of all the known Metals in dollars, pounds sterling, and francs.

	VALUE PER POUND AVOIRDUPOIS.		
	Dollars.	£ s. d.	Francs.
Indium	2,522	525 8 4	13,235·40
Vanadium	2,510	520 16 8	13,020·80
Ruthenium	1,400	291 13 4	6,291·65
Rhodium	700	145 16 8	3,645·80
Palladium	653	136 0 10	3,401·00
Uranium	576	120 0 0	3,000·00
Osmium	325	67 14 2	1,692·70
Iridium	317·44	66 2 8	1,653·80
Gold	301·45	62 16 0½	1,570·05
Platinum	115·20	24 0 0	600
Thallium	108·77	22 1 8	522·05
Chromium	58	12 1 8	302·05
Magnesium	46·50	9 13 9	242·15
Potassium	23	4 15 10	119·75
Silver	81·85	3 18 6½	98·15
Cobalt	7·75	1 12 3½	40·70
Cadmium	6	1 5 0	31·25
Bismuth	3·63	15 1½	18·91
Sodium	3·20	13 4	17·05
Nickel	2·50	10 5	13
Mercury	1·35	6 3½	7·85
Antimony	·36	1 6	1·85
Tin	·33	1 4½	1·70
Copper	·25	1 0½	1·30
Arsenic	·15	7½	·75
Zinc	·11	5½	·55
Lead	·07	3½	·35
Iron	·02	1	·10

Hence for the value of a pound of indium might be got 132,354 lbs. of iron, about 8½ lbs. of gold, 22½ of platinum, 135 of silver, 1,018 of nickel, 1,654 of mercury, 6,617 of antimony, 7,780 of tin, 10,180 of copper, 17,650 of zinc, and 24,070 of lead. *Les Mondes, Dec. 23rd*, 1875.

Metallurgy in Japan.—Minerals are very abundant in Japan. The principal iron ores employed by Japanese industry are the magnetic, specular, and red hematite. Two varieties of magnetic are found in Japan, one grey and the other black. This mineral is met with in very large quantities in the east of Niphon, at Sendai, and Numbri, and is highly esteemed for the manufacture of swords, needles, and compasses.

The blast furnaces of Japan are small, and of very simple construction, although built on the same principle as those of Europe. The walls are built of fireproof clay, mixed with a few stones. The blast furnaces are round, and have an opening at the side, closed by a band of clay; opposite are two other openings, through which comes a strong current of air, driven into the furnace by Chinese bellows worked by men. Before pouring the ore into the furnace they mix it with coal, and subject it to a previous calcination, so as to get rid of its carbonic acid, rock-milk, and sulphur.

The Japanese do not understand puddling as practised in the west; but the principle of their procedure is exactly the same. The fused iron, mixed with a little sand and pieces of iron, is again fused with charcoal in a second furnace, where it is left to cool for several days, until the whole mass has the appearance of fluid.

The Japanese method of making steel is quite different from that practised in Europe. They mix a certain quantity of iron in pigs and iron in bars, cover the mixture with borax, and melt the whole for a week in a small fire-proof crucible. The borax serves to dissolve the impurities in the dross. When the metal is separated from the dross, which floats on the surface, and cooled, it is hammered hard, and alternately plunged into water or oil, after which it is cemented and tempered. The mode of cementing is as follows: the steel, on coming from beneath the hammer, is covered with a mixture composed of clay, cinders, marl and charcoal powder. When this plaster is dry, the whole is subjected to a red heat, and the steel is afterwards cooled very slowly in warm water which is allowed to become tepid. Steel thus obtained is not very supple, but extremely hard, because it is not properly tempered or completely freed from its impurities. It would not do for making watch springs, but is used by the Japanese for swords and sabres which are tempered as many as eleven times, and knives which are tempered four times. *Le Constructeur.*

Corrosion of Zinc-plate.—Herr Frischen, a telegraph inspector, attributes the corrosion of zinc-plate to galvanic action. It is often nailed with iron nails. Coals also produce a galvanic current. Where a piece of coal falls upon a plate of zinc, as, *e. g.*, near a chimney, the zinc is soon attacked. Copper pipes are often soldered with zinc, and the soldering has to be repeated every two years. Gas and water-pipes always require less soldering, because they are soldered with lead. For lightning-conductors copper is used, nailed with iron nails, which are soon out of order. Surrounding lightning-conductors with coal has been recommended, but is destructive. Even the junction of cast iron with wrought iron causes a galvanic current. It has also been observed that zinc is easily corroded by contact with lime. *Bayerisches Industrie-und-Gewerbe-Blatt, Nov.*, 1875.

Processes of Nickelization.—PLAZANET'S process of nickelization consists, according to M. Herz, in employing a bath composed of 2 litres (3½ pts.) of water, 87·5 grammes (3 lbs.) of sulphate of nickel, 20 grammes (·7 lbs.) of sulphate of ammoniac, and 17½ grammes (·6 lbs.) of nitric acid.

According to M. BODEN, the bath usual in France may be obtained by dissolving 4 parts of nitrate of nickel in 4 parts of a solution of ammoniac and 150 parts of water containing in solution 50 parts of acid sulphite of soda. *Bulletin de la Société Chimique de Paris, Dec.* 20, 1875.

The Use of Nickel to Protect Magnets from Oxidation.—M. DUCHEMIN has found that nickel, deposited by electricity on the magnets of compasses, preserves them from oxidation. He deposited in this way a layer of nickel on several rings of one of his circular compasses, keeping two concentric circles free from the operation. This compass was put on board a vessel which went round the world. The rings covered with nickel preserved their polish, but the others were completely rusty. The magnetic power of the nickelized rings had been exerted with difficulty, no doubt on account of the magnetic property of the nickel.

The process employed for depositing the nickel is exactly the same as that pointed out by Messrs. Becquerel, and applied by Messrs. Folie and Mallié. The double sulphate of nickel and ammoniac well purified seems to give the best results. The anode or positive pole of nickel is obtained by putting the nickel in a coal retort crucible. *Comptes Rendus de l'Academie des Sciences, Nov.* 15, 1875.

§ 3. *Dyeing, Calico Printing, Bleaching, Tanning, and Allied Subjects.*

Treatment of Indigo-bearing Plants.—Plants which produce this colouring matter are plunged in vats till the water has deprived them of it to a great extent, and the liquid is then evaporated to obtain the indigo. A pretty high temperature is necessary during this steeping; but hitherto no use has been made of artificial heat, as it has been thought that the temperature of the surrounding air, which is generally high in the countries where this industry is carried on, is sufficient for the purpose.

M. OLPHERTS has tried the use of steam, and the results of his experiments in India, with rather rude apparatus, appear to warrant the change. The temperature of the water in the rainy season varies from 92° to 95° Fahr. In the vats it has been raised to 111°, and, in spite of the difficulties attending the new process, an increase of produce has been obtained of about 25 per cent. in comparison with plants of the same crop, steeped in the same vats, the same day, and for the same length of time.

Heat has also been applied during the beating, and good results have been obtained without injuring the colour or quantities of the indigo. Moreover, a fresh steeping for forty hours of plants treated with artificial heat gave no indigo, while those subjected to the ordinary process still retained some. *Technologiste.*

Inks for Topography, Lithography, Chromolithography, and Autography.—In the manufacture of inks for the above purposes Messrs. PERSOZ and JEANNOLLE make use of the heavy oils and pitch obtained from tar, but especially those from coal tar, which has hitherto been one of the most troublesome residues in gas-works. Experiment has proved that these oils, properly thickened, possess qualities suitable for printing. They have a certain degree of consistence, and combine well with soot and other dry coloured powders. When applied as ink, they do not stain through the paper or beyond the line of the impression as rich oils do which have not undergone a special preparation, and they may therefore be usefully employed instead of such oils, either wholly or partly, according to the nature of the product to be obtained.

When printing-ink is to be prepared, use may be made of the substances known by the name of evaporated tar or liquid pitch, with which a useful black ink may be obtained by simply thickening them with a suitable proportion of soot and Prussian blue, or other substances capable of supplying the tint that is wanted. The following recipe gives satisfactory results:—

Liquid pitch . .	100 parts
Soot	36 „
Prussian blue . .	10 „
Glycerine . . .	10 „

For preparing coloured inks use may be made of heavy oils, freed as much as possible from tarry substances, which would give them a brown shade, and coloured powders should be mixed with the oils. Heavy oils or pitch may also be used for lithography, chromolithography, and autography. Of course variable proportions of rich drying oils, or even grease and resin, should be added, according to the purpose for which the ink is to be used. *Moniteur Industriel Belge, Jan. 1st*, 1876.

Mode of testing Olive Oil used in dyeing Turkey Red.—To ascertain whether olive oil is pure and suitable for dyeing Turkey red, M. KOPP adopts the following process:—

Into an experimenting glass are poured ten volumes of the oil to be tested and one volume of ordinary nitric acid, to which are added some pieces of turnery shavings or red copper wire. The nitrogen forms with the nitric acid nitrous acid, the bubbles of which pass over the layer of oil floating on the top. The oil and the acids are immediately mixed as much as possible with a glass stick. In about five minutes the two liquids separate, and they are again mixed by shaking. The glass is then left at rest in a cool place with a temperature of 12° to 15° C. (54° to 59° Fah.), and separation again takes place, the nitric acid being of a blue colour, in consequence of the formation of nitrate of copper $(N O^3)^2 Cu$.

The oil then collects into a mass with a rapidity proportioned to its purity, the elaïdine being not only firm but perfectly white. When olive oil is mixed with other oils the formation of elaïdine is slower, and the substance obtained is more or less brown or yellow. *Technologiste, from Deutsch. Chem. Gesellschaft*, 1875.

Improvements in making Aniline Black for Dyeing or Printing.—M. PINCKNEY'S process for making aniline black consists in treating an aniline salt with compounds of vanadium or uranium, either alone or together with a nickel salt and an oxidizing agent such as the chlorates.

For dyeing, the textures are dipped in a mixture of the following substances, or first in the metallic bath and afterwards in the bath containing aniline salt and chlorate. The proportions of the various ingredients may vary according to the nature of the tissues to be dyed, but the following proportions seem best:—

Hydrochlorate of aniline	150 parts
Vanadium salt	18·5 „
Chloride of nickel	20 „
Chlorate of potash	100 „
Water	2500 „

The dyeing may be done cold or hot.

For printing the following proportions may be used:—

Hydrochlorate of aniline	150 parts
Uranium or Vanadium salt . . .	18·5 „
Chloride of nickel	20 „
Chlorate of soda or potash . .	150 or 100 „
Water	1200 „

Thicken with gum or dextrine. *Moniteur de la Teinture.*

Tanning of Leather by Electricity.—If an electric current is passed through a solution of tannin in a reservoir, the bottom of which is one pole, while the other is at the surface of the liquid, and skins are interposed during the passage of the current, a molecular transmission of tannin from one pole to the other is produced. This tannin thus passes through the skins, which are penetrated with it much more quickly than by the ordinary process. The stoutest leather is thus tanned in thirty or thirty-five days instead of twelve or fifteen months. The skins nearest the positive pole are always penetrated first.

The bottom of the vessel is formed of a plate, or collection of plates, in retort charcoal. A copper wire, surrounded with gutta percha, is fastened to this bottom, and rises along the vertical side. The upper surface is covered with a sheet of zinc, to which the negative pole is fitted. The two poles are in connection with a pile or a magneto-electric machine. The skins are arranged in the reservoir alternately with layers of bark in the usual way. *Bulletin de la Société Chimique, Nov. 20th*, 1875.

Purple Tint for Marking Linen.—A suitable preparation for this purpose is as follows:—Let 5 grammes (1·7 oz.) of sesquicarbonate of ammonium be neutralized in a porcelain mortar with nitric acid, and the perfectly neutral solution have 3 or 4 grammes (·1 or ·14 oz.) of carmine ground into it. As a mordant for the linen, use a mixture of equal parts of acetate of argillaceous earth and nitrate of tin. Linen or cotton thus treated and marked with the above preparation will, when perfectly dried, show a purple tint. *Industrie-Blätter, Dec. 30th*, 1875.

New Extract from Foreign Wood.—The attempts hitherto made to find substitutes for catechu, sumach, and tannin have generally been fruitless. M. DUBOSC has obtained the best results from a tree of Brazil, known in that country by the popular name of *quebracho*. The particular form of its grain, which resembles a small shield, has given it the scientific name of *aspidosperm*. Botanists place it in the family of *apocqueæ*.

M. Dubosc submitted it to all the operations which dye-woods generally undergo, viz., cutting into chips or pulverization, lixiviation on the principle of methodical exhaustion, evaporation, and lastly concentration, till the extract assumes the desired consistence as liquid, paste, or solid, according to the requirements of commerce.

The extract of *quebracho* thus obtained may be advantageously substituted for catechu, sumach, and tannin in all their applications both to dyeing and tanning. M. Dubosc is the first to think of using this wood for procuring an eminently astringent product, which is likely to prove a valuable acquisition to those arts. *Moniteur Industriel Belge, Jan. 1st*, 1876.

Method of recovering Indigo, Cochineal, Madder, and other colouring matter from Wool or Woollen Fabrics.—The wool or woollen goods containing indigo, cochineal, madder, or other colouring materials, are put into a digester capable of resisting a high pressure, and exposed to the action of steam at a very high pressure, till the whole is entirely dissolved. It requires about six hours for 1,000 kilogrammes (2,205 lbs.) with a pressure of 40 to 50 kilogrammes (88 to 110 lbs.) for every 3 square centimetres (about $4\frac{1}{2}$ square feet). When the solution is complete, water is added and boiled for a few moments, to render the mass more fluid. It is then strained through a coarse filter to separate the foreign substances, and through a second filter to separate the indigo, cochineal, madder, and other colouring matters. These colours are washed with water, again filtered, and dried. The solution which has passed through the filters is used either in the manufacture of prussiate of potash or sulphate of ammoniac, or for artificial manure. *Moniteur Industriel Belge, Jan. 1st*, 1876.

§ 4. *Food, Water, and Sanitary Matters.*

The Influence of varied Barometrical Pressure on Life.—M. BERT'S solution of this problem obtained the grand triennial prize of £800 from the French Institute on the recommendation of the Academy of Sciences. First examining the influence exercised on respiration by a diminution of pressure, he has proved, by decisive experiments, that changes in respiration are owing to the tension of the oxygen, which becomes insufficient. The quantities of oxygen and carbonic acid in the blood gradually decrease, and the result may be fatal. This is also the cause of that mountain sickness, well known to climbers, which appears in the form of extraordinary lassitude, severe headache, nausea, and bleeding. All these ailments may be removed without altering the pressure by breathing an air richer in oxygen than that of the atmosphere, and thus re-establishing the tension of the oxygen, and restoring the normal proportion of this gas in the blood.

M. Bert's investigation into the influence of increased pressure on respiratory phenomena has led him to an important physiological result. He has shown that oxygen, so essential to respiration, becomes a real poison when it is introduced into the system in excess. Thus too little oxygen kills through in-

sufficiency of organic combustion, that is asphyxia. Too much oxygen, or rather oxygen with an excess of tension, also kills. It must not be supposed that, if oxygen with considerable tension causes fatal results, it does so by inducing too active combustion. M. Bert has shown that oxygen in a state of high tension, far from acting with excess on combustible bodies, arrests their decomposition. Thus a piece of meat, hung in compressed oxygen possessing considerable tension, does not become tainted, and ferments in the same circumstances lose their chemical activity. Vegetables undergo similar effects under the same influence, and germination is retarded. In a word, oxygen, with sufficient tension, acts on organized bodies like heat, it paralyzes and kills them. Thus M. Bert shows that changes of barometrical pressure act on living bodies, not in a mechanical or physical way, but chemically. *Comptes Rendus de l'Académie des Sciences, Dec.* 27, 1875.

Contagion.—Observation and experiment have led M. CHAUVEAU, Principal of the Veterinary College at Lyons, to whom the Academy of Sciences has awarded the Lacaze prize for physiology, to the conclusion that the virulent action of vaccine matter, smallpox virus, and mucous humours, is not owing to the whole of those liquid substances, but generally to corpuscles which they hold in suspension. Hence it appears that the agent of contagion is not, as was formerly supposed, a subtle and mysterious principle emanating from the persons of patients, but a species of ferment capable of being seized, acted on, and consequently rendered harmless.

The professor has also ascertained that the agents of contagion are conveyed, not only in liquids proceeding from patients, but may also be transmitted to healthy persons through the medium of water and air. He has shown that smallpox is not, as has been maintained, a human disease weakened by passing through the cow, but originated in the horse. *Comptes Rendus de l'Academie des Sciences, Dec.* 27, 1875.

Production of Corn in Europe.—Some interesting particulars on this subject are furnished by Dr. BRACHELLI in his recently published "Comparative Statistics." The countries which regularly import corn are Great Britain, the Netherlands, Norway, Finland, and Montenegro, on account of unfavourable soil and climate; Portugal and Greece, on account of neglect in agriculture, and Switzerland. In Italy also, and often in France and Spain, the production of wheat is insufficient. The average annual production of corn of the different countries is as follows :—

	Total of hectolitres (2¾ bushels).		Per head of the population.
Russia	630	millions	9·1
German Empire	260	„	6·3
France	235	„	6·5
Austria and Hungary	215	„	6
Great Britain and Ireland	130	„	4·1
Spain	90	„	5·3
Italy	73·4	„	2·7
Roumania	50	„	10·4
Sweden	31	„	7·3
Belgium	24·5	„	4·8
Denmark	21·5	„	11·9
Netherlands	12·2	„	3·3
Portugal	11·1	„	2·5
Finland	6·2	„	3·4
Switzerland	5	„	1·8
Greece	4	„	3
Norway	31	„	3·8

Neue Deutsche Gewerbe-Zeitung.

Thymol as an anti-septic.—In a work recently published, Professor HUSEMANN has the following observations on the action of thymol, which is contained in oil of thyme.

The anti-septic operation of thymol gives it importance in practical medicine. In 1868 Parquet recommended it as a fragrant substitute for carbolic acid for disinfection and binding wounds. Hence oil of thyme, the chief ingredient of which is thymol, is used for making aromatic vinegar. Experiments made at Costa Rica have proved its value as an anti-septic in a striking manner. Bodies of animals poisoned by thymol continue a long time unaltered, even in hot weather, and meat and white of egg in a cold aqueous solution of thymol undergo no change with only an imperfect exclusion of air for eight or nine months, or even longer.

Lastly, even in the open air, when thymol is used in an aqueous solution of the same strength as another of carbolic acid, it is found more effective in preventing corruption, which may be easily accounted for, because carbolic acid is on the one hand far more volatile, and on the other more readily combines with other substances which are less anti-septic, or not at all so. As thymol is more fragrant and less poisonous and dangerous than carbolic acid, it deserves the attention of physicians, notwithstanding its high price.

How to make Raw Meat palatable to Invalids.—The following receipt for this purpose has been given by Herr IVON :—

Raw meat (from the loin) 250 grammes (8·7 oz.)
Shelled sweet almonds, 75 grammes (2·6 oz.)
Shelled bitter almonds, 5 grammes (·17 oz.)
White sugar, 80 grammes (2·8 oz.)

These substances are to be beaten together in a marble mortar to a uniform pulp, and the fibres separated by a strainer. The pulp, which has a rosy hue and a very agreeable taste, does not at all remind one of meat, and may be kept fresh for a considerable time, even in summer, in a dry, cool place. Yolk of egg may be added to it. From this pulp, or directly from the above substances, an emulsion may be prepared which will be rendered still more nutritious by the addition of milk.

Herr LAILLER prefers the following preparation :—

Dried raw meat, 100 grammes (3·5 oz.)
Sugar, 40 grammes (1·4 oz.)
Wine, 20 grammes (·7 oz.)
Tincture of cinnamon, 3 grammes (·1 oz.)

It is a kind of electuary, very agreeable to the palate. *Industrie-Blätter, Dec.* 30*th*, 1875.

Utilization of Cockchafers.—In the year 1872, great quantities of cockchafers were taken in Wurtemberg, and it was determined to try whether they could not be used for feeding swine. The experiment was made in the winter of 1872-73, at Hohenheim. The cockchafers, having been killed by boiling, were quickly dried in a wood kiln, crumbled with a potato-grater and stamped as firmly as possible into casks. For half a year the crusted material kept good, but at the end of that time maggots appeared. The chemical composition of the substance had in that period changed, the percentage of nitrogen having been reduced ·4 per cent. and the fatty substance 4·7 per cent. When fed exclusively on the cockchafers, the pigs rejected the coarser bits of wings; hence the substance was mixed with barley groats and made with hot water into a pulp, which the pigs devoured greedily without leaving any part. The cockchafers also proved useful when mixed in smaller quantity with the groats, and they are to be recommended in cases where the main substance of the food is deficient in nitrogen. *Neue Deutsche Gewerbe-Zeitung.*

Action of Ozone on Animal Substances.—In a communication to the French Academy of Sciences, M. BOILLOT states that during the great heat last summer he took a piece of fresh beef weighing 100 grammes (3½ oz.), and divided it into two equal parts. One was put into a flask closed with emery and containing common air, the other into a similar flask filled with air containing ozone in the proportion of 5 milligrammes (·015 grains) to a litre (1·7 pt.). The cubical contents of each flask were 200 cubic centimetres (11·8 cubic in.). They were then both put into a cellar at a temperature of 15° C. (59° Fahr.)

At the end of five days the meat in the first flask was quite putrid; but that in the other containing the ozone was as fresh as when it was put in. On the tenth day the second flask was again opened, and the meat found still quite free from taint; but, though the flask was quickly closed, putrefaction was evident the next day.

M. Boillot made a similar experiment with milk, using oxygen instead of common air, and obtained a similar result at the end of a week. *Comptes Rendus, Dec.* 20, 1875.

§ 5. *Fuel, Heating, Illumination, &c.*

Gas Industry in France.—From a report lately issued, it appears that in 1873 every French Department had gas-works except Lozères and Hautes Pyrénées. The total quantity of gas produced in 1873 was 315,815,540 cubic metres (about 11,132,497,785 cubic feet) from 478 establishments. The secondary products were 633,771 tons of coke and large quantities of gas-tar, ammonia, &c. The value of the products of the French gas-works was £4,611,365, of which £3,531,262 was for gas alone. The department of the Seine consumed as much gas as all the rest of France in 1873. *Neue Deutsche Gewerbe-Zeitung.*

Simultaneous Telegraphic Communication.—Herr SCHWENDLER, the head of the telegraphic department in India, has introduced on the direct line between Bombay and Calcutta a method of simultaneous telegraphic communication,

founded on his double equilibrium system, which worked so well during the rainy season that the government have determined to bring it into general use. With the method is combined a self-acting system by which interruptions on the line rectify themselves without having any influence on the telegraphic signals. Herr Schwendler has already applied for several patents for his inventions, and published a work containing part of the new laws on which the method is founded, and which must be observed to render simultaneous communication practicable on long lines. *Neue Deutsche Gewerbe-Zeitung.*

§ 6. *Miscellaneous.*

Correlation of Chemical and Electro-dynamic Forces.—M. FAVRE, to whom the French Academy of Sciences has recently awarded the Lacaze prize for chemistry, has furnished experimental confirmation of Mr. Joule's doctrine as to the equivalence of heat and work done, by ingenious experiments with his mercurial calorimeter converted into a thermometer, in the reservoir of which one or more elements of the pile could be placed. In this way he has shown that the heat developed by the resistance to the passage of electricity is simply borrowed from the total heat due to the chemical action which engenders the current. If this resistance is annulled, the result obtained as the work of the pile with closed current is the quantity of heat which would be due to the chemical action alone, without the transmission of electricity. Such results confirm M. Favre's views as to the correlation of chemical and electro-dynamical work done. *Comptes Rendus de l'Académie des Sciences, Dec.* 27, 1875.

Trade of Russia with Asia.—The general commerce of Russia with foreign Asiatic countries has reached the following amounts during the last few years :—

	1869. Roubles.	1872. Roubles.	1874. Roubles.
IMPORTS FROM			
China	5,146,000	2,825,000	3,481,000
Khiva	4,752,000	4,000	3,000
Persia	1,749,000	1,693,000	1,429,000
Asiatic Turkey	3,535,000	3,552,000	3,470,000
Bukharia	877,000	——	——
Country of the Kirghises	5,251,000	——	——
Other countries	546,000	1,257,000	529,000
Asia in general	21,859,000	9,332,000	8,904,000
EXPORTS TO			
China	5,332,000	8,015,000	6,525,000
Khiva	1,551,000	17,000	1,000
Persia	5,221,000	4,924,000	3,948,000
Asiatic Turkey	4,553,000	6,275,000	5,446,000
Bukharia	3,454,000	——	——
Country of the Kirghises	4,518,000	——	——
Other countries	85,000	3,000	10,000
Asia in general	24,715,000	19,234,000	15,930,000

The general exports of Russia to Western Europe amounted in 1869 to 256,507,000 roubles, and in 1872 to 317,709,000 roubles. The imports amounted in 1869 to 324,101,000 roubles, and in 1872 to 415,991,000 roubles. *La Gaceta Industrial, Dec. 25th,* 1875.

Liquid Glue.—The following preparation of liquid glue has been recommended. Dilute phosphoric acid with two parts by weight of water, and saturate it with carbonate of ammoniac. The liquid, which must still be acid, is to be diluted with one part of distilled water and warmed in a porcelain vessel on a steam bath.

Dissolve in it so much Cologne or Flemish glue as to produce a thick syrupy solution. Glycerine and sugar syrup are to be avoided, as they render the glue gelatinous again. The liquid glue must be kept in bottles carefully closed. *Industrie-Blätter, Dec.* 30, 1875.

Simple test of the Genuineness of Rich Oils.—Herr MERZ observes that, if two different kinds of oil are mixed in a glass vessel, their different optical action produces the so-called bands or stripes—a phenomenon well known to every one from the preparation of sugar water. If, therefore, these bands appear on mixing genuine oil with the oil to be tested, the impurity of the latter may be inferred.

The trial is made as follows :—Pour into a test-tube about 2 centimetres (·78 in.) wide, a layer 4 centimetres (1·56 in.) deep of the oil to be tested, and into another vessel a similar quantity of genuine oil. Put both test-tubs for ten minutes into a glass of water of the ordinary temperature, that the oils may reach the same temperature. Then pour one oil into the other still standing in the water, and stir the mixture round with a wire at intervals, to see whether the bands appear. To get accustomed to the phenomenon, trials may be made with olive oil, rape oil, and linseed oil. If any two of these are mixed, strongly marked bands will be seen. *Deutsche Industrie-Zeitung.*

The Finances of the United States.—In the course of six years 400 million dollars (about £80,000,000) of the national debt of the United States have been paid off, so that it is now reduced from 2,110 million to 1,700 million dollars. In addition to this, there are about 400 million dollars of greenbacks. The reduction of the debt in the past year amounted to 20 million dollars, and it is probable this rate of reduction will be maintained. The total revenue of the government in the last fiscal year was 288 million dollars. The expenditure was, for civil administration, foreign affairs, machinery and improvements in the arsenals at the ports, 21½ million dollars; for the interest of the public debt, and bonds in circulation, and promotion of railways, 109 millions; and for the collection of the revenue, and the construction and maintenance of public buildings, 50 millions. The balance at the Treasury on the 30th of June, 1875, the end of the fiscal year, was 145 million dollars. The expenses for the war department amounted to 42 million dollars.

The Census in Germany.—On the 1st of December, 1875, a census was held in Germany under the authority of the imperial government. Some of the results have already been published, subject, however, to future correction. The population of Berlin at the present day is 964,755, which is an increase of 17·7 per cent. since 1871. Hamburg contains 385,895, inhabitants, or 13·83 per cent. more than in 1871, Breslau 237,398, an increase of 15 per cent., Hanover 126,000, an increase of 2·7 per cent., Königsberg 119,127, an increase of 100 per cent., Leipsic 126,412, an increase of 15 per cent., Dresden 106,378, an increase of 19 per cent., Frankfort 103,234, an increase of 13 per cent., and Strasbourg 91,257, an increase of 8·72 per cent. Before the French and German war there were 200 French workmen in Berlin, there are now 2,400. *L'Economista, Jan.* 9, 1876.

Statistics of Sewing Machines.—The following results are supplied from America :—In the three years 1871, 1872, and 1873, no less than 4,788,742 sewing-machines of American manufacture were sold. Of these 922,426 were on the chain-stitch system, 1,123,278 on the lock-stitch system, and 2,738,038 on Singer's shuttle system. Of these last, 1,397,202 were supplied by the Singer Manufacturing Company at an average of £16 13*s.* 4*d.* each, producing a total of £9,314,680. *Bayerisches Industrie-und-Gewerbe-Blatt, Nov.* 1875.

The Commerce of Egypt.—According to the "Sémaphore" of Marseilles, the exports from Alexandria amounted in 1861 to about 73 million francs. They increased up to 1865, but have since continued to decrease. On the contrary, the imports have increased. The goods admitted into the port of Suez and sent out amount to an average of 50 million francs a year. Consumers in Egypt pay more regard to the cheapness than the quality of goods. Saltpetre is manufactured in government factories. The crude nitrate, made in middle and higher Egypt, undergoes refinement in a large government establishment near Cairo, which produces an average of 450,000 kilogrammes (990,000 lbs.) yearly.

New Maximum and Minimum Thermometer.—The activity with which deep-sea explorations have been carried on of late makes the want of a good and cheap minimum thermometer more keenly felt. Mr. DUCLAUX recently communicated to the French Academy of Sciences a new principle for the construction of maximum and minimum thermometers. He has found by experiment that two liquids can be mixed together, of such a nature and under such circumstances, that on a change of temperature they immediately separate from each other, one resting on the other with a sharply defined surface between them. The chemical composition of the two liquids remains precisely the same after the separation as before, and only their relative volumes are altered. The same result occurs if three liquids are mixed, when, as is generally the case, the third has no influence on the separation of the other two, and remains at the same degree of concentration in each of the two separate layers as in the original liquid. The only difference is that the third liquid modifies the molecular relations of the other two and renders them soluble in each other, thus serving as a bond of union between them. They still separate, when the original equilibrium is destroyed, into two layers, between which the third liquid is uniformly shared.

For example, a mixture of 15 cubic centimetres of amylic

acid, 20 of ordinary alcohol, and 32·9 of water, though clear and homogeneous above 20° C., becomes thick and separates into two layers on reaching that temperature. Similar mixtures, containing more or less water, would give the same result at other temperatures. They may be very easily prepared by taking the required quantities of amylic and ordinary alcohol, keeping them at a fixed temperature, and adding water, drop by drop, till a slight thickening is observed, which can be dispersed by the slightest addition of heat. The mixture being put into a tube, which is closed by fusion in a lamp, will always thicken and separate into two distinct layers on reaching the temperature at which it was made, and nothing but raising the temperature or violent shaking will make them unite again. The distinction between them may be rendered still more evident by adding to the original liquid a few drops of red ink or ammoniacal carmine, which colours the whole liquid as long as it continues homogeneous, but is concentrated in the lower layer, leaving the upper almost colourless as soon as separation ensues.

Instruments made on this principle have the disadvantage of requiring a special mixture for each temperature; but they are easy to make, cheap, and strong enough to bear shocks and pressure, and are well suited for sea-soundings. They may also be of use in rooms, hot-houses, and wherever it is of less consequence to know the temperature with precision than to prevent it from falling below a certain degree. *Comptes Rendus de l'Académie des Sciences.*

Process for Making Wax.—A patent has been obtained in Paris for making an artificial wax which, it is said, may prove an advantageous substitute for bees' wax. The base of it is resin, which differs from wax in containing less hydrogen or more carbon and oxygen, and consequently may be turned to wax by adding hydrogen or taking away carbon.

Either the resin is melted with half its weight of paraffin or some other carbonized substance, at a temperature not exceeding 108° C. (230° Fahr.), when the resulting product closely resembles wax in composition; or the resin is melted with one-third of tallow or stearic acid, and afterwards weakened by potash. Copal or vegetable wax may be added to the compound. *Bulletin de la Société Chimique, Jan.* 5, 1876.

Alfa.—This grass, which extends over thousands of acres on the high plateaus of Algeria, is becoming more and more important. It has for some years been employed in this country as a material for textile manufacture, and the refuse for making paper. In Spain there are several factories in which alfa is used for these purposes. The processes of bleaching are very rude there, and consist of exposing the alfa to the sun or washing it in alkaline baths. The following is a good course of treatment: 1, steeping; 2, dipping in whitewash; 3, washing; 4, reduction to the condition of tow; 5, bleaching in chloride of sodium. *Bulletin de la Société Chimique de Paris, Nov.* 20, 1875.

Bamboo as Raw Material for Paper.—Mr. T. ROUTLEDGE strongly recommends the use of bamboo as raw material for the manufacture of paper. Having made careful experiments, he has come to the conclusion that no other plant can be produced so abundantly with so little trouble and cost. In suitable climates and places it requires no special attention, and grows with remarkable rapidity. In the garden of the Khedive a plant shot up 9 inches in a single night. In the garden of the Duke of Northumberland a gigantic specimen reached the height of 60 feet in twelve weeks, and at Kew a growth of 3 feet in a week has been observed. The loss of weight in drying amounts to 75 per cent., and about 60 per cent. of the remainder consists of fibre suitable for paper-making, the net yield of an acre being 6 tons. The plant grows abundantly in most parts of India, Africa, and Central and South America. Hitherto it has not been found to answer, because the plants used were too old, with hard fibre and a thick silicious coating, which rendered it necessary to have recourse to long boiling in strong solutions of caustic alkalies under a pressure of ten or eleven atmospheres. Mr. Routledge recommends the careful selection of young plants, which are to be first passed under crushing rollers, to get rid of all lumps and knots and split the stalks. They are then to be further split up into strips by fluted rollers, and afterwards cut to suitable lengths by a chopping apparatus, as a preparation for boiling in pans connected by pipes through which caustic alkali circulates from one to the other. The fibre is lastly to be washed, pressed, divided, and dried in hot air.

Method of Reeling Imperfect Silk Cocoons.—It is well known that many of the cocoons obtained from silkworms cannot be reeled. These consist for the most part of those which the fully developed moths have bitten through on coming out. With silkworms reared artificially they form the exceptions, but with those bred in the open air in the East they are the general rule. Such cocoons are used as floss silk and submitted to a spinning process, all attempts to reel them having proved abortive. The difficulty of reeling them arises from the admission of water into them, which sinks them to the bottom of the vessel, and makes them too soft to be reeled. M. Le Doux remedies this evil by putting into the open cocoons artificial ones made of vulcanized india rubber with a small opening in them. The india-rubber cocoon, which is squeezed up to get it into the silk one, is spread open with a needle through the small hole till it fits into the outer one all round, and fills it out so as to prevent it from sinking in the water, and render it as fit for reeling as any other.

Of course the india-rubber cocoon must be of the same shape and size as the other. Hence it is necessary to have an assortment of all sizes ready. The reeling must also be more slowly and carefully done near the opening of the cocoon, where the silk is weaker, but the extra trouble will be repaid by the value of the silk. The method has not yet been reduced to practice, which is the only satisfactory test of its utility. *Stummer's Ingenieur, Dec.* 10, 1875.

The Oil Tree.—From a scientific article in the "Siècle," by M. POUCHET, we learn that there is a tree in China and Japan called the oil tree. Its botanical name is *olæococca vernicia.* It belongs to the order *euphorbiaceæ*, another plant of which produces crotona oil. M. Cloez has found by experiment that by strong pressure without heat a limpid, colourless, inodorous, and almost tasteless oil may be extracted from its seeds to the extent of 35 per cent. of their weight. If this oil is kept from air in a closed tube, and heated to 100° C., or even 200°, it retains all its original limpidity after cooling; but, if it is raised to the same temperature in contact with the air, it becomes solid after a time, suddenly changing to a sort of firm transparent jelly, no longer sticking to the fingers, and easily breaking up into angular fragments which do not unite together. The solidification is caused by the absorption of a certain quantity of the oxygen of the air, and is not peculiar to this oil. The only peculiarity is, that in this case it is instantaneous, while generally it requires some time. It also appears, from the experiment, that this oil is more drying than any other yet known. Another peculiarity of this oil is that it becomes solid under the influence of light alone, apart from the air. This curious property of light may be turned to account by men of science who seek to transform luminous vibrations into mechanical work. *Moniteur Industriel Belge, Dec.* 20, 1875.

PARLOUR ORGANS.

ALTHOUGH perhaps not coming strictly within the scope of the "Practical Magazine," a short notice of George Woods and Co's parlour organs will not prove uninteresting to our readers, as they comprise many successful novelties not hitherto attained in this class of instruments, and are, besides, an importation from America of comparatively recent introduction.

These instruments have already obtained great and marked recognition from the members of the musical profession—men who are allowed to be judges of what is good and excellent in their particular sphere, and whose verdict the general public need have no hesitation in adopting. The importance of music as a means of recreation and aid to refinement for the hard-worked practical man need not be enlarged upon here—its beneficial effects are universally admitted.

The novelty in these organs which most attracted our attention was the pianoforte stop, whereby all the sparkling effects of a pianoforte are obtained, combined with the advantages of an accompaniment of a sustained bass, and enabling dance music to be played with capital effect. This stop consists of steel bars, which are struck by hammers in a similar manner to the mechanism of a pianoforte; the tone is of exquisite quality, and it possesses the further advantage of never getting out of tune. This stop can be used as a solo, or in combination with any other stop or combination of stops. The following extract, from a Boston contemporary, suggests the value of this addition.

"The musical result, the power, animation, and brilliancy given to the reed stops by the addition of this new stop, is something wonderful. Used alone, the new stop at once suggests the name that has been given to it—'piano.' It is not like the reed tone, but is a bright, ringing one, such as is given by a good piano string. It is as persistent as a piano string, and

mingles with the reed tone without difficulty. It may be combined with any other stop without hesitation, as it seems to enhance and brighten the tone, whatever its pitch or character. United to all the stops it gives the organ increased power, and aids greatly in sustaining the tone, so that at a distance the general effect is heightened, and made more striking and pronounced.

"In rapid passages, scales, &c., and in dance music, an organ having the piano stop stands unrivalled for sparkling vivacity and distinctness of utterance. In concerted music, where orchestral effects are desired, the new stop gives the organist an array of facilities for tone-colouring and expression that has never been obtained by any instrument that has ever been made, either here or in Europe. As it has a 'vanishing tone,' like the pianoforte, and is used with the same keys that move the reeds, some peculiar combinations of the mingled, sustained, and vanishing tones were shown to us that we had not supposed were possible in the hands of one player. As these various effects were shown to us, we could not help thinking that a new school of playing would grow out of the introduction of this most remarkable instrument. Not only does it demand an organist to bring out the colouring and varied pitch of the reed stops, but the technical skill of the pianist also. The organist finds the brilliancy of the piano added to his organ, and the pianist has the resources of the organ with his piano.

"This idea of uniting the piano and organ is not a new one. It has been often sought for by the makers of reed instruments, but never before has it been brought to perfection, and to the inventive skill and perseverance of the house of George Woods and Co. is due the final result, practically carried out in a convenient and comparatively inexpensive form. The combination of reed organ and pianoforte has been attempted before. The old Æolean attachment partly succeeded, but after all it was a very poor reed organ in a pianoforte. Other attempts led to the introduction of strings into the organ case, but the same obstacle constantly presented itself. The string was being constantly affected in pitch by the temperature, and would never stay in tune with the reed.

"Then came the idea of substituting steel bars in place of strings, and out of this idea have come the splendid results we now see and hear.

"Many different forms of bars were tried, the first being a simple straight bar, used with an upright action; but the present form of bar and action were finally fixed upon as the most desirable. Months of labour were consumed in determining the most desirable form of bar to be used, the particular form of sounding-board to be used in order to 'bring out' or develope the tone, and the form of bridge or intervening medium between the bars and the sounding-board. As the instrument is now constructed, the sounding-board for the 'piano' answers for the ordinary back of the organ, which ensures simplicity of construction and freedom from multiplicity of parts. One difficulty which has constantly presented itself has been that of different parts of the instrument having a tendency to vibrate, or 'jar,' when the blows have been struck by the hammers; these have now been overcome, and the instrument is now as free from these defects as an ordinary piano. To give the whole history of the growth of this remarkable invention would demand more space than we can command. It would be as interesting as novel to trace the patient steps taken by the senior member of the house in his years of experimenting in this field. The matter was kept a secret as much as possible while it was being brought to perfection, and is now fully covered by patents that are the exclusive property of the firm.

"Perhaps the most peculiar property of the new stop, aside from the character of its tone, is its steadiness in keeping in tune. In fact, there can be no material disagreement of pitch by reason of a variation of temperature."

The combination solo stops also claim our attention, and are the subjects of patents here and in the United States. They impart to the instrument a great capacity for the production of musical effects and orchestral variations, and give to the reeds a peculiar and flexible quality of tone. These consist of the Vox Humana (16 ft. pitch), a baritone solo; it is a distinct set of reeds, and the paste-board fan, which is used in other instruments to produce the effect of the human voice, is here discarded. The Æoline (8 ft. pitch) is a soft or breathing stop, of delicate quality. The Concert Flute (8 ft. pitch). The Celeste (8 ft. pitch) has a desirable string-like tone. The Tremolo, very simple in construction, can be used on a solo stop without affecting the others. There are the other usual stops, octave coupler, &c., all going to make a most complete chamber organ.

The cabinet-work is worthy of the character of the instrument. It is well executed, and the design is effective without being frittered away in flimsy fret-work. Our engraving is an illustration of one of the more elaborate instruments.

TECHNICAL INSTRUCTION AND THE VIENNA BUILDING AND ENGINEERING SCHOOL.

THE following report was presented to the Austrian Union of Engineers and Architects by Herr Wencelides, chief engineer of a large foundry and machine manufactory, after having visited and inspected the Building and Engineering School at Vienna. He prefaced his report by some general observations on the importance of technical instruction to workmen, and especially foremen, who have to carry out the ideas of the architect and the engineer, and on whom the success of their work so materially depends. It is highly important, as he rightly observes, to have skilful workmen able to appreciate the value of theory, and not prejudiced by ignorance against it. They should be able to modify their practical operations on scientific principles, and study the foundation on which their acquired practical skill is based. The more intelligent they are, the more they may be trusted to carry out the views of their superiors; just as the more intelligent use the rank and file of an army, the more successfully will the plans of the general be executed. It is of course still more needful that foremen and masters of works should receive technical instruction.

Herr Wencelides says that in 1866 he was engaged to give gratuitous instruction to the workmen in a large machine-making establishment. A room on the premises was specially appropriated for the purpose, and the men assembled twice a week for an hour immediately after leaving off work. He taught them arithmetic, geometry, physical science, geography, and history, the head of the establishment undertaking the practical department of the instruction in machinery and mechanics. At first there was a numerous attendance, and a lively interest manifested on the part of the men; but after a time the master was too much engaged to continue his part of the teaching, and the number of attendants gradually dwindled down to three. It was not till a later period, when Herr Wencelides had become better acquainted with the men's real requirements, that he understood the cause of this failure. He says he ought in arithmetic to have shown them how the areas of curved and flat surfaces are calculated, and how the radii of different wheels for the different inclinations in screw-cutting are found. In mechanics he should have explained to them the theory of simple machines in their application to lifting and moving heavy weights, the strength of ropes and chains, the use of the windlass and the lever. He ought to have taught them the use of simple instruments for measurement, as the rule and compasses, the set square, the protractor, the water-level, &c., showing them how measurements are made, how the accuracy of simple instruments may be tested, and how a set square or water-level may be modified. He ought to have called their attention to the difference between wrought iron, steel, and cast iron, as well as the properties of metal in general. He ought to have introduced to their notice the most important industrial countries and districts, and pointed out to them how much influence discoveries in physics and mechanics have upon the welfare of the people and their history. These and other matters experience has taught him are the proper subjects for technical instruction, the success of which depends both on the matter and the manner of the teaching.

But, important as technical instruction is for the workman, and still more for the foreman and master of works, it is not all that is necessary. The foreman should be a self-reliant man, possessing self-knowledge and a knowledge of men in general, fond of order, conscientious and upright, alive to the interests of the workmen, without betraying those of his employer. Under such a foreman the work-people are in harmony, and show an interest in their work.

After these general observations, Herr Wencelides proceeds to an account of the mechanical department of the Technical School at Vienna. The object of the school is to train mechanics, engine-fitters, foremen, millwrights, and mechanical draughtsmen. The pupils of the machine training school consist, in a great measure, of young people who have just left school. But a preference is rightly given to those pupils who are already able to show some practical skill. Herr Wencelides thinks these should constitute the whole of the school, and consequently the lowest age for admission ought to be raised above fourteen. No further preparation is required for the school than what may be obtained at the public elementary schools or the town schools, yet most of the pupils have gone through the lower and upper modern schools, which, though a gratifying proof of the esteem in which the Technical School is held, does not meet with Herr Wencelides' approval. He says the parents make a mistake in

GEORGE WOODS AND CO.'S PARLOUR ORGAN.

sending their sons to the modern schools under the idea that after such preparation they will make better progress in the Technical School, but they forget that a youth so prepared is not likely to become what they intend. He enters the Technical School at the age of seventeen to nineteen, not as a mere beginner, for he has already learnt to draw and knows something of machinery, and he thinks he can more easily earn his living as a draughtsman, which is possible enough, but requires that he should remain nothing but a draughtsman. If, on the contrary, a lad goes directly from a town school or lower modern school to the Technical School, acquires practical knowledge there, and afterwards advances to the machinery department, he is likely to turn out a good workman, and before long a skilful foreman, provided, of course, he has natural ability. And a skilful foreman is a person in great demand. In such a case the Technical School would accomplish its professed object.

The course of instruction there extends over three years. Herr Wencelides confines himself to the most important features, particularly drawing and other subjects closely connected with it. In the preparatory department a foundation is laid for a correct understanding of drawing by instruction in orthographic projection and drawing from wire outline models, which exhibit the elevation and the plan. They begin with a point, and then proceed to the representation of a line, a plane, a solid object, the intersection of a line with a body, of a plane with a body, of two bodies, &c. Thus, in a simple and progressive way, they attain to the representation of an object in elevation and plan, and are able to form an idea of an object from seeing its elevation and plan.

In the machinery department they begin with copying well-executed drawings of the elements of machinery—as screws, rivets, joints, pulleys, blocks, &c. Then simple objects are set before them, of which they are required to make free-hand sketches, accompanied by figured dimensions, having themselves taken the measurement with rule and compasses. The objects are then drawn geometrically in full size. They extend from simple screws to the most complicated objects. During this time mechanical instruction goes on, and the pupil is made familiar with the properties of simple machines—as the windlass, crane, whim, &c. He is thus assisted in his attempts to draw them correctly. Herr Wencelides reports that the drawings he saw showed a correct knowledge, and were highly satisfactory.

Mechanics and machinery are taught in a simple and popular way. The sound principle is adopted of not attempting too much, but doing what is done thoroughly. Hence important parts of machinery are presented to the pupil again and again, to impress upon him the value of the principles they illustrate. There is no attempt to go deeply into theory, for which the pupils are not qualified.

A praiseworthy feature of the instruction is the special attention bestowed upon mechanism for the regulation of steam-engines and locomotives. The pupils are enabled by means of ingenious apparatus to learn the various modes of regulation and the action of valves. The school possesses a good collection of well-executed models, which are valuable means of instruction.

In the machinery department great importance is also rightly attached to the different kinds of pumps, from the simplest to the most complicated. Every machinist, engine-fitter, and foreman must thoroughly understand the construction and action of pumps.

The mechanical knowledge thus gained is considerable, and thoroughly sound as far as it goes. In addition to this, instruction is given in chemistry, metallurgy, the different furnaces, and the properties of metals. Then they proceed to the different tools employed for working in metals and wood, and learn modelling and easting. The making of machines, mills, and waggons also receives attention, though not quite so much as Herr Wencelides thinks desirable. Mechanical drawing is pursued in this department, and applied to the copying of well-made stoves, tools, and machinery, by which they are impressed on the pupil's memory in all their variety of form. For these objects there are no instruction books; hence the pupils have to write down the lectures and make the necessary sketches for themselves, which they do without difficulty. Their note-books are their best memento of the school in after life.

It may be gathered, from what has been stated, that the school is in the right way to fulfilling its professed purpose. It is animated by intelligence and zeal. The professors are young and able. All that the school needs is the countenance and support of the industrial and trading interests. It wants good drawings, which can hardly be bought, various models or separate portions of machinery of the latest and most improved construction; and the professors require such hints, encouragement, and advice from the heads of large industrial establishments as none but practical men in their position can give. *Wochenschrift des Osterr. Ingenieur-und-Architekten-Vereines, Jan.* 8, 1876.

Engineering, Building, &c.

ABSTRACTS FROM FOREIGN PERIODICALS, TRANSACTIONS OF SOCIETIES, ETC.

§ 1. *Engineering.*

COMPARISON between Steam Engines and Engines worked by Hot Air, Gas, Petroleum, &c.—M. FRITZ, Professor of Mechanics at Zurich, has drawn up tables from all known documents and the results of his own experiments, showing the comparative expense of fuel and work done by steam-engines and engines worked by hot air, gas, petroleum, &c. From these tables it appears that engines worked by hot air are inferior to steam-engines, and those worked by gas equal to them; but none, though seeming to present advantages, surpass the steam-engine, and only very small ones worked by gas and hot air have yet been constructed. Experience is still less favourable to these engines if the cost of construction and maintenance be taken into account. For those worked by gas it is twice as much as for the most imperfect steam-engines, for condensing gas-engines five times as much, and for petroleum engines twice as much. But, though no other engines at present appear capable of superseding the steam-engine, it cannot be denied that they possess certain advantages over it for particular purposes, and especially for minor industrial operations. *Technologiste, from Deutsche Industrie-Zeitung, Aug.* 1875.

Dress Wool or Mineral Cotton.—This substance, employed for enveloping pipes, reservoirs, &c., of water or steam, to prevent cooling, has for some time been prepared in metal-works by passing a current of steam over fused dross. It is white or greyish, and the filaments are strewn with little glass globules perceptible to the touch and falling down when shaken. The length of the threads sometimes reaches 5 centimetres (nearly two inches), but most of them are much shorter. When the substance is squeezed, a gnashing is heard, owing to the breaking of the threads or perhaps only their rubbing. It is not hygrometrical, but capable of retaining much water.

Mineral cotton is a very bad conductor of heat. When placed on the skin, it produces a sensation of heat. In order that pipes, &c., may be effectually prevented from cooling, they must be covered with a layer of mineral cotton 7·5 centimetres (nearly 3 inches) deep; thus a surface of a metre square (nearly 11 square feet) requires 4 kilogrammes (nearly 9 lbs.) of the substance. No sensation is felt on touching a steam pipe thus covered. The net cost of mineral cotton is 7·5 francs (6*s.*) for 50 kilogrammes (110 lbs.). *M. H. Meidinger in Chemische Centralblatt.*

Improved Apparatus for Miners and Divers.—Among the prizes recently awarded by the French Academy of Sciences was one obtained by M. DENAYROUZE for improvements in apparatus to protect workmen in a medium unfit for respiration. The apparatus, to which he has given the name of *aërophore*, is composed of a sheet-plate reservoir, with three cylinders side by side. This reservoir is filled with atmospheric air, having a pressure of 25 to 30 atmospheres, by means of a pump of special construction, and sends forth the air by means of ingenious self-acting regulators, under a slight pressure and at the convenience of the workman. An india-rubber tube connects the reservoir with the mouth, and is terminated by a flat piece of india rubber with an opening in the middle, the edges of which are inserted between the lips and gums so as to fit exactly and completely stop up the mouth, thus preventing the admission of any air except through the tube from the reservoir. The regular action of respiration is insured by two valves in a sort of case, one of which, near the reservoir, opens on a slight inspiration, while the other is closed against the outer air. On the contrary, during expiration, the former is closed and the latter open. The whole apparatus may be put upon one's shoulders like a military knapsack, which it resembles in form and weight.

When the workman is employed in a medium which might injure his eyes, he is furnished with spectacles fitted into an india-rubber mask which excludes the air from the nose. The ordinary safety-lamp, with some necessary modifications, is employed to give light. As no lamp can burn in air vitiated beyond a certain point, M. Denayrouze supplies pure air from the reservoir. The produce of combustion escapes into the surrounding atmosphere under a slight pressure, regulated by a valve which prevents the admission of bad air. Upon the same principle M. Denayrouze has constructed a burning lamp under water at any depth, affording sufficient light for submarine ope-

rations, which are further facilitated by an acoustic tube intended to put the worker in communication with those above, enabling him to hear them by means of a vibrating plate, and to make himself heard by them on simply articulating the words in the interior of his helmet. The air becomes unfit for respiration, not only when it is vitiated, but also when the pressure deviates too much from the normal pressure at the surface of the sea, as on high mountains or in balloons. In these cases, also, M. Denayrouze's apparatus, which has been tried with success, might be useful. *Comptes Rendus de l'Académie des Sciences, Dec.* 27, 1875.

Cork Covering for Steam Pipes.—For some time past HERR PRORHASKA, of Vienna, has adopted a method of covering for steam pipes which in many respects surpasses all others. Strips of cork, from 10 to 20 millimetres (·39 in. to ·78 in.) thick, are cut like staves of a cask, and bound fast round the pipe with binding wire. It is well known that cork is a bad conductor of heat, and its moderate price is a recommendation. It is easily bound round the pipe even when curved, and may be removed for leakages, &c., without injury. According to French accounts, the marine engineers have made experiments with cork as a non-conductor, and reported favourably to the Admiralty, which has given orders to provide the five naval ports with this material. *Bayerisches Industrie-und-Gewerbe-Blatt, Nov.* 1875.

Apparatus for registering the number of turns made by the Engine of a Steamer.—The French Academy of Sciences have awarded the Montyn mechanical prize to M. MADAMET, for his indicator of the number of turns made by the engine of a steam vessel. It is composed of two heavy masses, subject to a rapid rotatory movement about an axle, towards which they are impelled by springs, and which is moved by the steam engine in such a way that the ratio of the numbers of turns remains constant. The centrifugal force of the revolving masses, and consequently their distance from the axis of rotation, varying with their angular velocity, a transmission mechanism converts their diverging motion into that of a needle on a dial bearing legible readings.

This use of centrifugal force is not new; but its application on board a vessel to the construction of an instrument far away from the engine, and not so affected by the motion of the vessel as to cause serious errors, is at once a novel and difficult achievement. M. Madamet has prevented error from the motion of the vessel by managing that the centre of gravity of the two revolving masses shall always be in the same position, whatever their divergence from the axis of rotation, and that the influence of the moments of inertia may be neglected. By various ingenious contrivances he has made it easy to place the indicator in any part of the ship, so that the officer on the bridge can at any moment see the speed of the vessel. M. Madamet tried his apparatus with favourable results in 1869, and he has since made some improvements in it. A commission appointed by the French Admiralty to test its value reported most favourably of it last November. *Comptes Rendus de l'Académie des Sciences, Dec.* 27, 1875.

Results of experiments with Zinc as a Preventive of Boiler Incrustation.—The directors of the Main-Neckar Railway ordered trials to be made of zinc, as a means of preventing the incrustation of boilers, at the central workshops at Darmstadt. The boilers there used are exclusively cylindrical. Such boilers, with all their advantages, have the disadvantage of being very liable to incrustation between the cylinders, and requiring to be frequently taken out and cleaned. As the feed-water at the central workshops contains a great quantity of hard substances, and consequently deposits much incrustation, the cleaning of the boilers is always troublesome and expensive. Hence it was determined to try the effect of zinc as a preventive. For three months it was employed, from 6 to 10 kilogrammes (13 lbs. to 22 lbs.) being put into a boiler every month, in pieces about the size of one's fist. The boiler was then taken out, and the cylinders appeared at first sight entirely free from incrustation. On closer inspection it was found that, in one or two little places where the water entered, the cylinders were covered with rather a thicker incrustation, but of quite a loose character. In every other part the covering was scarcely thick enough to be measured, and nowhere more than half a millimetre (·009 in.) thick.

In the interior of the main body of the boiler a strip of incrustation, 30 centimetres (about a foot) broad, appeared like a sort of dew round the sides, while at the bottom there was only a blue-blackish slime, which was easily removed by a besom and water. It is to be observed that the boiler had been in use four months before the zinc was put in, otherwise the result would have been still more strikingly decisive. Altogether 22 kilogrammes of zinc were used.

The same quantity was put into a new boiler of the same construction but rather larger dimensions. After this boiler had been in use four months, and from time to time 33 kilogrammes (72½ lbs.) of zinc had been put in, it was taken out and found to be covered with a thin layer of a millimetre and a half (·06) thick. The cause of this less favourable result seems to have been the larger size of the boiler and greater quantity of steam made, while there was no increase in the quantity of zinc used. Perhaps, also, the boiler was left too long before the water was let out, ten days having elapsed instead of three, for it is just when the water is at rest that the sediment is formed.

The only disadvantage arising from the use of zinc was, that towards the end of the effective stroke of the engine it was apt to sputter at high speed. *Bayerisches Industrie-und-Gewerbe-Blatt.*, 1875.

§ 2. *Building, Decoration, &c.*

The Strength of different kinds of Wood.—Herr HIRN has lately tested the strength of various pieces of wood. The pieces tested were 29 millimetres each way, or 841 square millimetres in area, and subjected to torsion by a weight at the end of a lever one metre long. The oiled woods were for two or three days in a warm bath of rape oil at a temperature of 80° to 100° C. (177° to 212° Fah.), and then cut to the above dimensions. The result, in almost all cases, was a considerable increase of strength, so that the single exception of elm wood, the strength of which was reduced from 920·7 kilogrammes to 827·6, may perhaps be owing to other causes. In the following table there is a striking relation between the co-efficient of strength and the specific gravity. If the number 1378, corresponding to the resistance of the best cast iron, be compared with that of the weakest wood, poplar, represented by 2841, it is evident that in many cases wood can compete with iron.

No.	Material tested.	Specific gravity.	Weight breaking at the end of a lever one metre long.	Ratio of strength to that of poplar=1.	Proportional resistance of one kilogramme of the material.
1	Poplar . . .	·352	424·0	1·000	2·841
	Ditto, oiled .	—	460·3	1·086	3·085
2	Deal	·356	527·6	1·244	3·494
	Ditto, oiled .	—	527·6	1·244	3·494
3	Chestnut . .	·480	636·2	1·500	3·125
	Ditto, oiled .	—	765·5	1·805	3·760
4	Pear-tree . .	·688	977·6	2·305	3·350
5	Pine (not affected by the oil) . .	·536	1008·6	2·407	4·491
6	Elm	·552	920·7	1·952	3·536
	Ditto, oiled .	—	827·6	2·537	4·596
7	Acacia . . .	·632	1075·0	2·757	4·362
8	Oak	·732	1169·0	3·147	4·299
9	Box	·938	1334·5	3·196	3·407
10	Hornbeam . .	·784	1355·2	3·953	5·042
	Ditto, oiled .	—	1675·9	3·233	5·124
11	Beech . . .	·684	1370·7	3·623	5·297
	Ditto, oiled .	—	1536·2	3·391	4·958
12	Cherry . . .	·640	1536·2	3·623	5·661
	Ditto, oiled .	—	1526·2	3·843	6·005
13	Ash	·748	1629·3	3·843	5·138
14	Nut-tree . .	·676	1748·3	4·123	6·099
	Ditto, oiled .	—	1929·2	4·550	6·731
15	Cast iron . .	6·800	3620·7	8·539	1·256
	Ditto	6·800	3972·4	9·368	1·378

Deutsche Industrie-Zeitung, Sept. 1875.

Pyrography.—This name is applied by Herr SCHURING, a drawing-master of Flensburgh, to the art, which he has invented, of burning drawings into wood, and employing them for internal decoration wherever wood surfaces are to be adorned. Such drawings have already been put on sideboards, wainscoting, &c. They are remarkable for durability, warmth, and softness, and may be washed without sustaining any injury. *Industrie-Blätter, Dec.* 20, 1875.

IMPROVED DROP HAMMER.

A VOLUME might be written upon the hammer and its uses. The historian, if adhering to the Scriptural tradition, would doubtless begin with the labours of Tubal Cain, in the days before the Flood; or, if inclined to Darwinism, with the probable efforts of our simian ancestors to break the hick envelope of the cocoa-nut by pounding it with stones, in order to reach the food within; or, if not committed to either belief, his opening sentences would tell of the stone implements of the cave-dwellers (inhabitants of the world ages ago), which now are found mingled with the bones of strange creatures long since passed from the face of the earth. Tracing the history of the hammer from the rude pestle of the barbarian, through the ages of stone and iron, up to the present day, he would find its use a necessity in every trade, its forms of infinite variety, extending from the tiny implement of the jeweller, barely a fraction of an ounce in weight, to the colossal mass of a hundred tons of solid metal, delivering its blows with almost terrific might.

It is to the worker in metals that the hammer is the most important of tools, and it may be interesting, especially in connection with the subject of this article, briefly to note the adaptations of the implements to meet the requirements of the forge. The hand sledge, swung by the powerful arms of the smith, no longer able to cope with the increasing size of the work to be fashioned, gave place to the apparatus driven by machinery.

The most ancient of forge hammers is probably the tennant helve, known in France as the marteau frontal, a heavy mass of cast iron lifted by projecting arms fixed in a cam ring and falling through a certain space by its own gravity. Then came the tilt hammer, which, instead of being raised at the front end, was depressed by a cam ring from a part projecting behind. Another improvement on the original tennant helve was to lift the helve between the head of the hammer and the pivots on which it works. The last innovation, and the one which has remained longest in use, is the belly helve, which is raised under the bottom part of the helve by means of a bray, which could be lengthened or shortened according to the size of the piece to be acted upon. After all appeared the steam hammers in their various forms, possessing capabilities to the future extent of which no limit can be set. With these, however, we have not now to deal, for it is our object at present to refer simply to efforts made to drive hammers in connection with motors, and not by the direct application of the source of power to the implements themselves. While the steam hammer is susceptible of a great variety of uses, there are circumstances under which a device of the first-mentioned class may serve certain purposes with even better results, while in other respects the latter may be sufficiently efficient to meet all requirements. As a particular instance of this, we take occasion in the following description to direct attention to a new machine for the making of forgings by a single blow, by forcing the metal into suitable dies. Hammers, both hand and power, have always been used for thus moulding plates of metal, and one of the best known mechanical forms is the Oliver, an apparatus governed by the action of a spring pole controlled by the foot of the workman. The difficulties, however, with the large majority of the old implements in use preceding the introduction of the steam hammer, and indeed in many now employed, seem to be loss of power by gearing, trouble in regulating pressure or adapting it to work required, and the fact that the head, moving as it does in the arc of a circle, does not, on thick metal, strike a direct blow.

A glance at the engraving of the machine herewith presented will at once demonstrate that two of the disadvantages above cited are absent, viz., the complicated gearing and the indirect stroke; and the following explanation will show that the force and extent of the blow can be governed with the utmost certainty and ease.

The heavy hammer-head, which is constructed to weigh from 300 lbs. to 1,800 lbs., travels between two uprights, and to it is attached a board of white oak or other suitable wood, which passes between two smooth friction rolls located in the upper portion of the machine. These rolls revolve in opposite directions, and each is driven by a separate pulley from one driving shaft, with cross and open belts. When they are closed together and pressed against the board, their friction upon each side of the latter raises it, and thus elevates the hammer; then, when the rolls are separated, the head is free to fall by its own gravity. The mechanism by which the operation is effected will be understood from the sectional view, fig. 2, in which A A are the rolls, and B the board between them.

The shaft upon which the front roll is keyed runs in eccentric sleeves, one of which is shown at C, which are placed in stationary boxes. Hence, when these sleeves are rotated a small portion of a circle, the front roll is moved nearer to or further from the rear roll. To the arms of the sleeves is attached a drop rod, D, which connects with a lever, and the latter with a treadle. We will suppose the hammer to be at the upper portion of the frame, and to rest upon the latch shown at the right. This latch, it will be seen, is adjustable, and may be pivoted at any elevation, and is connected with the treadle bar. When the workman presses the treadle down with his foot, he raises the drop bar, D, and, as is evident, at the same time pulls back the latch. Raising the drop bar causes a separation of the rolls; and, the latch also being removed, the hammer, being unsupported, falls. At that instant, the blow being delivered, the operator removes his foot from the treadle, the drop rod then falls, and the eccentric sleeve turning the front roll, aided by the pull of the belt, is forced against the board, raising the hammer up again. If it be desired to give a series of heavy blows, the latch is thrown back out of operation and the hammer allowed to rise until it strikes a projection upon the drop rod; this it impinges against and rises, and so lifts the rod, causing, as we have shown, a separation of the rolls. The position of the projection on the drop rod is such that the latter will be lifted by the upper surface of the head when the hammer rests upon the latch, so that the machine may be left thus set, the rolls not gripping the board until the rod is lifted by the treadle. The

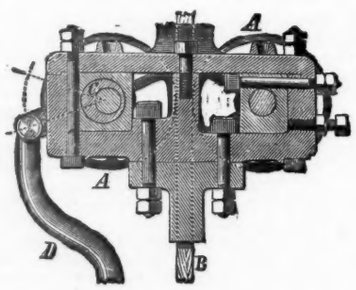


Fig. 2.

hammer, as a moment's consideration will show, follows the motion of the foot, and blows of any degree of shortness or lightness may be delivered. It may be instantly arrested at any point of the stroke by simply removing the foot from the treadle, and thus caused to rise without delivering its blow. In a word, the machine is under complete control of the operator, and is managed with perfect facility. In order to compensate for the gradual wearing down of the plank, the movable box in which the rear friction pulley has its bearing is provided with two screw bolts, as shown on the right of fig. 2. The upper of these bolts extends through the box, but the lower one only to the outer side. After loosening the upper screw bolt the lower one can be turned in, thus pushing the box closer up to the board. Then, by tightening the upper bolt again, the box is rigidly secured in place.

As we stated in the outset, although the apparatus is excellently suitable for any variety of forging, it is especially adapted, by reason of its quick sharp blow, and the means provided of instantly catching the hammer and preventing rebound, for the making of drop forgings. The articles which can thus be formed by the aid of dies are remarkably numerous, and, when this simple and quick mode of producing them is considered in connection with the labour of casting or cutting them from the metal, the economy is obvious. Numbers of articles, such as wrenches, scissors, set-screws, rings, bolts, hooks, and small portions of machinery, are thus instantly and accurately stamped out, requiring but a little finish to complete them. The metal is heated and placed in the lower die, but not in such a quantity as to fill the same. As the drop falls, the blow forces the material into all the recesses of the mould, of which the exact shape is reproduced. We would remark here that it is quite common to place the hot metal above the die, and drive it down, doubling it up, so to speak. The result of this is that the air in the die is tremendously compressed, and forces its way out, scoring the cast steel of the latter almost as sharply as if done with a file. Again, but a single blow should be delivered, as the first stroke usually spreads out a thin sheet of metal on the surface of the

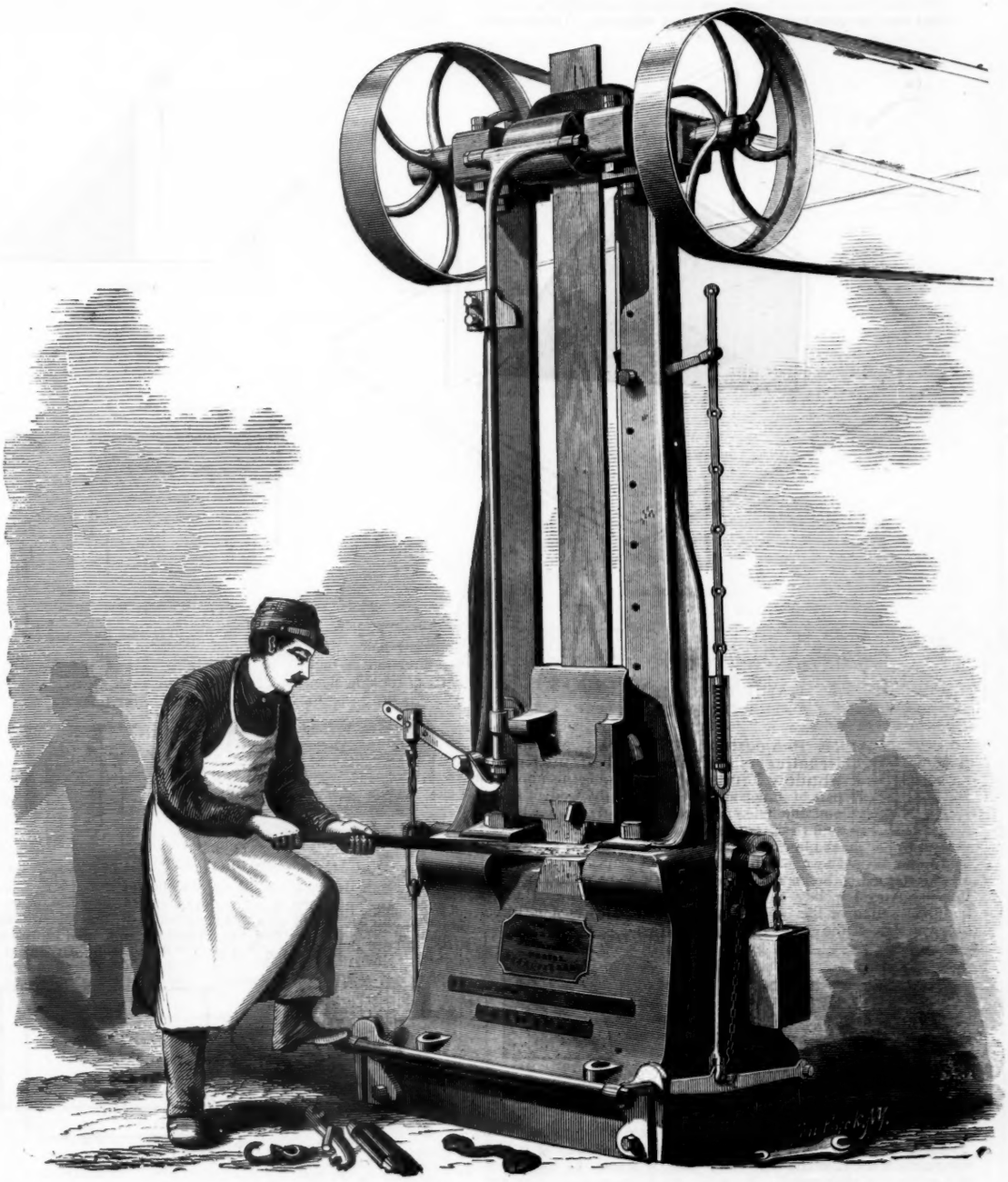
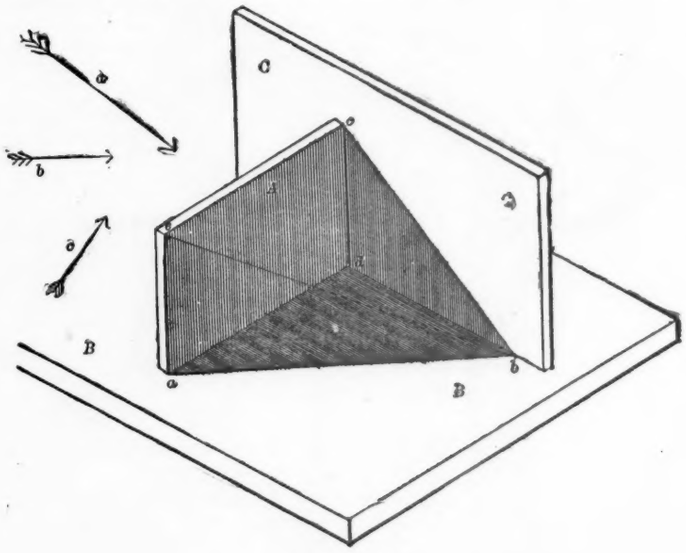


FIG. 1.

IMPROVED DROP HAMMER.

die, which rapidly cools. If this be struck by the hammer, not only will the forging be thrown out of shape, but the die itself is liable to injury.

The uses to which this invention may be put needs no further explanation, as to the practical mechanic its advantages will be clearly apparent. Its operation is simple and within the comprehension of the most ordinary workman, and the materials used are strong and durable. A board will last several months, and may be readily replaced at trifling expense. The manufacturer informs us that a large demand for the machine has already sprung up. The Prussian government, through Messrs. Pratt and Whitney, have already ordered thirty machines, and others have been shipped directly to the Spanish and Turkish governments; the Baldwin Locomotive Works employ five, and the Providence Tool Company twenty-five, while some 180 hammers have been all made during the past two years. For further particulars, address Messrs. Charles Merrill and Sons, No. 556, Grand Street, New York City. *Scientific American.*



Figs. 608 and 609.

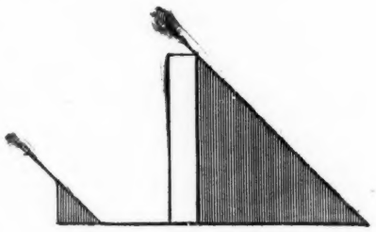


Fig. 610.

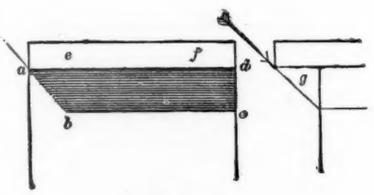


Fig. 611.

THE PRACTICAL NOTE-BOOK OF TECHNICAL INFORMATION USEFUL TO STUDENTS AND WORKMEN.

(104.)

THE Projection of Shadows, and of the Practice of Shading and of putting in Shadow Lines.—In considering this important part of projection and drawing, the student should note the difference between the terms. A body is said to be "in shadow," or the parts of a body are said to be "in shadow," when the direct rays of the sun or light are intercepted by another body or bodies placed between them, thus depriving the body, or the parts of a body, of the light. A body is said to be "in shade" when it is not exposed to the direct action of the rays of light, or that part which is turned from the source of the light, the converse or opposite of this being that a body, or the part of the body towards the light, is said to be "illuminated." The part of a body or the ground on which a shadow falls is termed the "plane of the shadow." The rays of light coming in a certain angle towards the body, the parts of that body necessarily throw shadows, or cause the light-rays to fall in such directions as to form certain outlines, these outlines defining the extent and the form of the shadow. It is in finding these outlines that the department of drawing known as the "projection of shadows" concerns itself with. These "shadow lines" must not be confounded with "shade lines." Thus, for example, in fig. 611, the lines *a b c d* are "shadow lines," that is, the lines which indicate or point out the direction or outline of the shadow cast by the projecting part, *e f* (in side elevation at *g*). So also, as in fig. 615, the line *a b c d* is the "shadow line;" but in fig. 619 the lines *a b*, *b c*, *d e*, *e f*, are "shade lines," or the curved line, *a b*, in fig. 620. "Shade lines" are lines used in outline drawings to show the projecting parts, and are put in on a principle which will be afterwards explained. Now, in fig. 609, the dark parts indicated by the lines *a b*, *b c*, *c d*, *d a*, is the "shadow" cast by the flat object, *A*, standing on its side on the point *B*, and projecting from its end from the point *C*. The light is supposed to come from the side next the arrow, as in fig. 608, thus throwing the "shadow" named above, while the side *a e c d* is thrown into "shade," the side opposite, as well as the remaining portions of *B* and *C*, being "illuminated." The term "shaded," moreover, must not be confounded with a drawing in which the "shadows" are put in. "Shading" is a term used to indicate the method employed to

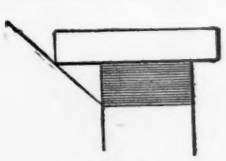


Fig. 612.

Fig. 613.

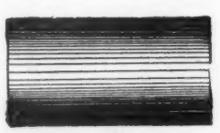


Fig. 614.

Fig. 615.

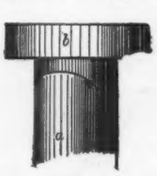


Fig. 616.

Fig. 617.

give to objects the appearance of being rounded or flat—see a succeeding note on "*shading*." Thus, in fig. 615, the "shadow," *a b c*, is put in, but the drawing is not "shaded;" but in fig. 616 the object is both "shaded," so as to show that the parts *a* and *b* are rounded, and it has also the "shadow," the outline of which, *a b c*, is given in fig. 615. Thus, in fig. 617, the outline of a flat object is given, in which neither "shadow lines" nor shaded surfaces appear at all. As drawn, it conveys no idea

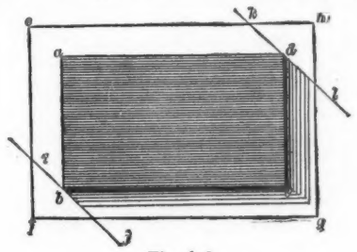


Fig. 618.

save that of the bare outline of a rectangular object, or a parallelogram, *a b c d*, which may have, or may not have, the attributes of a solid body. But in fig. 618 we have a very different condition of subjects introduced. We here see that *a b c d* is a rectangular block possessed of a certain thickness, lying or placed upon another surface, *e f g h*, the shadow of which block, *a b c d*, is thrown upon the surface *e f g h*, and is represented by the darkened part, the lines, as *i j k l*, giving the outline of these three lines, being at the angle, as already explained, and also as in

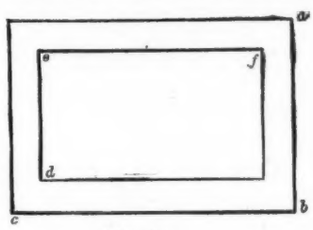


Fig. 619.

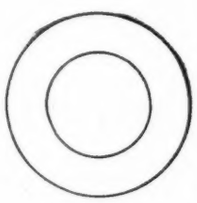


Fig. 619 A.

next paragraph. In fig. 619 the same object is so shaded that we now see that the rectangular object, as *a b c d*, fig. 618, is depressed, or below the level of the surface of *e f g h*, this effect being obtained by drawing in the shade line, *e f*, horizontally, and the shade line, *e d*, vertically. The same principle of shade lines is illustrated in figs. 619, 620, 621. In fig. 622 the upper diagram shows the upper half of a hemisphere with a hollow in it, the lower diagram the lower half. In fig. 623, *a* shows the upper half of a hemisphere, with a circular flange, *b b*, lying upon

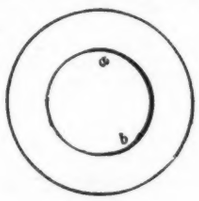


Fig. 620.

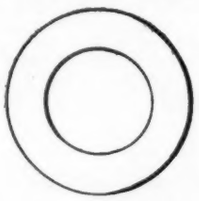


Fig. 621.

a rectangular board, *c d e f*, the line *g h* being in shade line, showing that there is a projection at that part.

In the "projection of shadows," the rays of light are supposed to come in a direction oblique to the object. It is found convenient to use the angle of 45°, and the light is supposed to come from the left hand, so that the dark, or shadow side, is always towards the right hand. Continental draughtsmen assume that the rays of light come from the right, thus throwing their shade lines vertical to the left. Ignorance of this gives rise to confusion in the minds of many of our draughtsmen, who assume that there must be an error in the foreign drawing. The light is supposed also to come from above the object, although it may also strike on the object or be thrown upon it from below. The angle of 45° is convenient, for it agrees with the planes of projection, which are at right angles to each other, the line dividing these planes being a line at an angle of 45°. Suppose *A*, in fig. 609, to be a plate standing upon the base, *B*, and projecting at right angles from the point *C*. Draw the line *c b* at an angle of 45° with the vertical plane *C* or *A*, and the line *a b* at the same angle with the horizontal plane *B B*; join the outer angle, *e*, of the object *A*, with the point *b* where the lines *a b*, *c b*, inter-

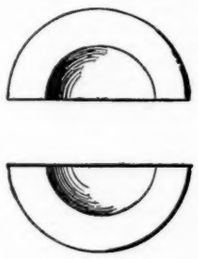


Fig. 622.

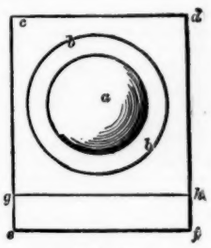


Fig. 623.

sect, and the line *c b* will be at the angle 35° — 16°. This is the correct angle or direction in which the sun's rays strike an object, or the angle which they form with the horizon; but, as before said, that of 45° is more convenient, "mitering," so to say, with the two planes, *C* and *B B*, fig. 609, and further, because it enables the rays to be drawn with the greatest facility by the use of the "set square." This will be made clear by inspection of the figs. 610, 611, 612, and 613.

We have shown that a "shadow" is caused by some body coming between the sun's rays and the plane on which they otherwise would have been cast, thus proving that the shadow must always be at the side opposite that from which the light comes. Again, all light comes to an object in straight lines, which for convenience are termed "rays," and these rays, if not arrested in their course, strike the plane which is parallel with the horizon, and which are termed the "horizontal plane," or if there be placed upon this, as in fig. 609, a vertical plane at right angles to the horizontal one, then the rays will strike this, and these being infinite in number, so to say, will "flood" these planes with light, and cause them to be "illuminated." But, if any body not transparent be placed between the rays and the plane, then a "ray" or a straight line of light will pass from the part of that body to the plane, and intersect it at a point corresponding to the position of the part of the body; in other words, it will project the point on to the plane, and give the "shadow" of that point on the plane. And, as a body is made up of a number of points, the projections of these points on the plane. being joined by straight or curved lines, will give the outline of the shadow.

WATER CONTRIVANCES IN INDIA.

THE contrivances used in India for raising water, and for other purposes, are of a rather primitive kind, and our engineers have something to do to instruct natives in some of the simplest of our appliances. A pump, as we have it, is comparatively unknown, a kind of chain pump being used, with pots or leather bags attached. These primitive appliances sometimes frustrate the calculations of our engineers unaccustomed to them, and a few facts may be interesting, which Mr. Lowis D. A. Jackson, in his "Hydraulic Manual," furnishes us with. Our English mode of bucket baling is unknown in India. Instead of this, the natives use a flat kind of dish, made of leather or wood bark, rendered water-tight, and stiffened by a frame. At each side cords are fastened, the ends of which are held by two men, who, by a quick mode of dipping and swinging, raise the water to the receptacle above. For clearing foundations where there is swinging room it answers very well, the lift being generally about 5 ft. About 400 cubic feet of water per hour, or 20,000 gallons per day of eight hours, may be raised. The "beam and bucket" contrivance is a rather more scientific appliance for raising water by hand labour. It consists of a large earthenware vessel suspended at one end of a beam, which is rather thick, and so poised on a fulcrum by a counter weight

at the other end, that the force of one man may easily raise the vessel when full.

The "picotah" of Southern India is a development of the principle; a long tree becomes in this case the balance-pole, which is worked by the weight of a man, who walks or runs up and down along the heavier arm of the lever. Another man manages the vessel, and the height of the lift is sometimes as much as 20 feet. The smaller appliance previously described we find can raise 82 cubic feet per hour, or about 4,100 gallons per day. Another similar contrivance is called the "dal," or "jantu." This consists of a wooden trough or gutter working on a pivot. It is worked usually by cords. As much as 21,000 gallons can be raised by this simple means in a day, and a lift of 5 feet, with two men, can be performed. Another very primitive method of raising water is by the "mot," which is a vessel made of ox-hide, bound to a wooden hoop, raised and lowered by a cord over a pulley by oxen, the animals performing the work by descending an inclined plane, and the bucket sometimes emptying itself by a catch cord. A more advanced mechanical appliance, like the ancient chain of pots used in Egypt, Syria, and by the Romans, is called the "Persian Wheel." It is composed of two endless ropes, united and passing over a wheel, the endless ropes hanging a little below the water in the well; earthen or leathern vessels are attached to the loop, which, after being filled, discharge into a trough through the vertical wheel, which is double. Motion is given by a vertical shaft, turned by bullocks. Our modern chain pumps are constructed on this plan. This last appliance is undoubtedly more economical as a labour-saving machine, and is used largely in Northern India. This appliance, lifting 40 feet, will raise 16,500 gallons per day, if it has a double chain of pots. All these methods, however, require a good coefficient of reduction to be applied, as amount of work is lost by leakage, imperfect construction. *Van Nostrand's Engineering Magazine*

USE OF GASEOUS COMBUSTIBLES IN BLAST FURNACES.

IN order to work blast furnaces with mineral combustibles of recent formation, M. REISER proposes to introduce from without, in the different zones of the furnace, hot gases, which are to effect the reduction and carburetting of the metal, while the mineral combustible has a direct action in the quarter where the fusion takes place, and maintains the porosity of the column of mineral.

To carry out this process, the following conditions must be fulfilled: 1. The shaft of the furnace must be as low as possible, to prevent the weight of the materials from exerting a pressure which, besides crushing a combustible naturally friable, would have the further disadvantage of diminishing the porosity of the fusion column, which, on the contrary, is promoted by the introduction of hot gases into the upper parts of the furnace. The little height of the shaft is also useful for preventing the subsidence of mineral, which might often occur from the tendency of raw combustible materials to be disintegrated by heat.

2. The transverse section of the furnace ought to be elliptical, like a Raschelt furnace, which, with an enlarged mouth and a comparatively slow escape of gases, draws at a less height. On the other hand, the action of the wind extends more easily to the centre of the furnace, which causes a more uniform ascent of gases, and consequently ensures the regularity of the general action.

3. Carbonic oxide and air must be introduced to the upper part of the reduction zone by means of a series of air pipes, the air being in a suitable proportion to ensure the combustion of the carbonic oxide and reach the temperature necessary for reduction.

4. Gases must be also introduced into the carburetting zone, according to the quantity of raw combustible which has been put into the furnace. Carburetted hydrogen would be suitable for reaching the necessary heat, but its production would be too costly, and it is sufficient to blow with carbonic oxide containing a little carburetted hydrogen as it is naturally produced.

5. Moreover, the introduction of carbonic oxide with the wind blown is in all cases an advantageous operation.

6. Lastly, all the gases blown in air—carbonic oxide and carburetted hydrogen—must be well heated.

By acting according to these directions, the following advantages, according to M. Reiser, may be secured:—

1. The possibility of using, both for preparing the hot gases and feeding the furnace, a combustible cheaper than coke, charcoal, or anthracite. The unfavourable results hitherto obtained from the use of these combustibles, though they might develop a heat sufficient for the fusion of reduced and carburetted iron, arise on the one hand from the subsidence mentioned above, and on the other from the fact, that the heat necessary to transform these combustibles into coke in the upper parts of the furnace is such that the mineral is only imperfectly reduced and carburetted when it comes to the tuyères.

2. Economy in the quantity of combustible, owing to the facility and readiness with which the particular reactions are accomplished, on condition of following a very precise rule for the composition and introduction of the gases intended to produce reduction and carburetting.

3. Easy access to the furnace, and the possibility of instantaneously altering its action.

4. More complete utilization of the calorific power of the gases, resulting from the perfect combustion in the upper zones of the furnace.

5. The power of completely controlling the action of the furnace by means of the introduction of gases into its upper parts, so as to obtain a powerful reduction of the mineral, without at the same time producing a too decided reduction of silicium. The mere blowing of hot gases into the furnace, as it is generally practised, developes an excessively high temperature, which has the effect of reducing the proportion of silicium so much, that it has to be remedied by an excess of lime-flux, which increases the expense by impoverishing the fusion beds.

6. A considerable reduction in the amount of combustible introduced into the furnace. The limits of this reduction are easily ascertained by practice.

7. The power of working for a longer time and more easily, minerals eminently reducible and dross which, melting before their complete reduction, might cause irregularity in the advance of the work in the reduction zone, where the most energetic action is developed. *Annuaire de l'Académie des Mines de Leoben.*

1. CHAIR AND 2. CONSOLE.

DESIGNED BY MARTIN KUNBEL.

3. TABLE.

DESIGNED BY OPPLER, ARCHITECT, OF HANOVER.

THIS style of chair is copied from the handsome mediæval forms of the Renaissance, and unites great convenience with beauty, being especially adapted for dining-rooms when executed in antique oak. The console is intended for holding lamps or vases for mural decoration. The centre is intended to be covered with velvet to furnish a coloured background for the object in front. The ornamentation may either be gilt or coloured.

Fig. 3. Sofa-table belonging to the furniture suite of Mr. Wejermann at Hagerhof, is copied from the few specimens preserved from the 14th century. The centre joists are somewhat less massive and executed in more graceful detail, but the general principle of construction is preserved. In place of the modern pillar feet we find cheek pieces beneath the plane of the table, and upheld below by slanting supports. The table is executed in walnut by Sichel, upholsterer, of Hildesheim, at a cost of £9 15s.

THE STUDIES AND DISCIPLINE PREPARATORY TO THE PRACTICE OF THE TECHNICAL PROFESSIONS.

No. III.

CIRCUMSTANCES have of late given very marked prominence to the subject of Technical Education, taking this term as indicating a system by which a knowledge of special branches of science and art can best be conveyed to those classes engaged either in the direction and control, or in the practical working out of the many departments of our national industry. Amongst the causes which have led to this prominence being given to such an important subject, the following may be named, and will suffice to convey a general idea of its present position. Several of our leading manufac-

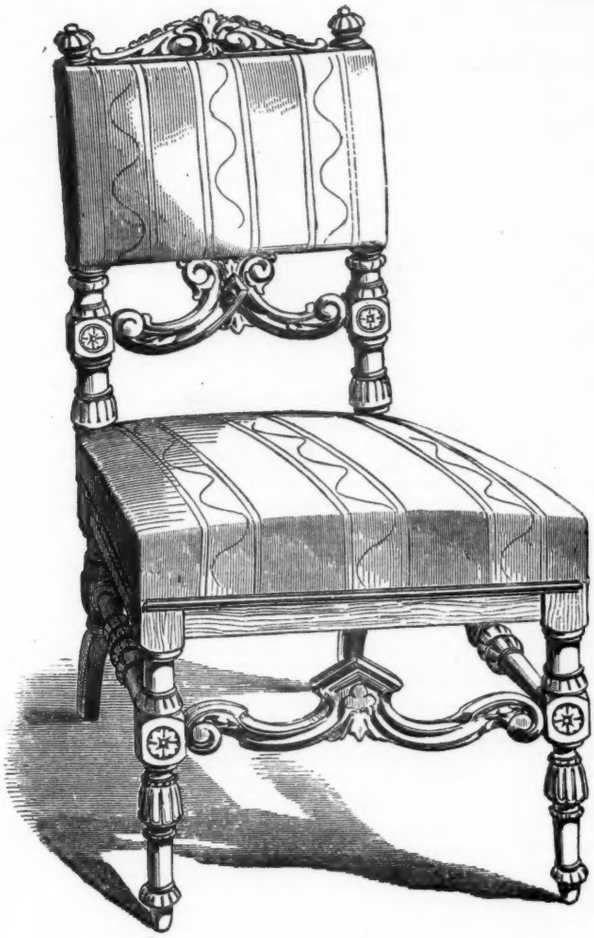


Fig. 1.

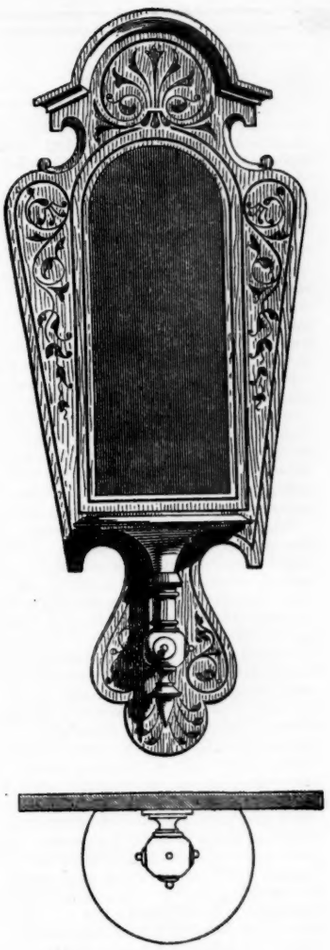


Fig. 2.

1. CHAIR. 2. CONSOLE. DESIGNED BY M. KUNBEL.

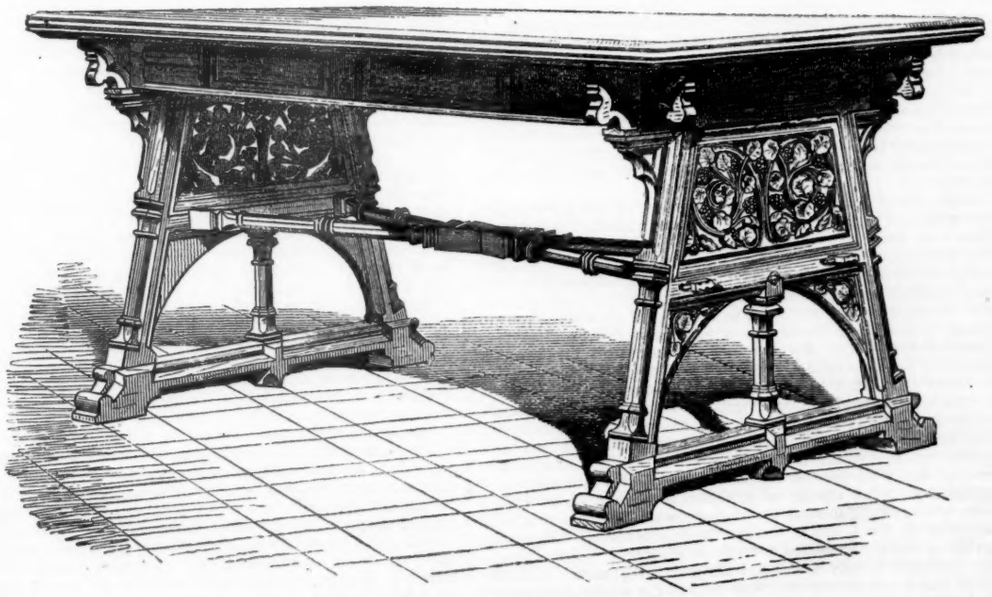


Fig. 3.

3. TABLE. DESIGNED BY OPPLER.

turers, eminent engineers, and others intimately connected with various branches of the arts and manufactures, and profoundly impressed with the marked character of the competition carried on abroad—a competition so keen and close as seriously to have interfered with their business returns—paid a series of visits to the Continent. The object they had in view was to trace if possible this competition to its source, and to ascertain whether it was likely to be of a permanent and growing character, or the result merely of one of those temporary changes, so to say, which every now and then give rise to developments of special branches of industry, but which soon die out, and leave no permanent trace or mark upon trade. They had also in view, as one of the most important points into which examination would be essential, to ascertain what was the real state of the education of the workmen abroad, and how far this was influenced by, and likely to be of practical value to them in their daily work, in consequence of an infusion into it of a knowledge of technical subjects. Of this they had heard much, and they were desirous to learn more, and to aid them in this they possessed the advantage of knowing intimately the state of education in this country as existing—and in too many cases as they well knew, not existing at all—amongst the same classes here.

The result of these visits—and they were laboriously and conscientiously carried out, and the observations that were made were of the closest and most careful character—was to prove beyond a doubt that the working classes of the Continent nearly everywhere enjoyed the advantages of a system of technical education, which from the soundness of the principle on which it was based, and the wide range of subjects which it embraced, and all bearing in the closest manner upon the actual every-day work in which they were engaged, gave to them a power to design and conceive, and an ability to carry out, work of the highest class and the most difficult character:—a power and an ability which was fast placing them in the position of being most formidable rivals to that industrial ability and energy of which as a nation we have held up till now nearly the practical monopoly. Contrasting this state of matters with those which existed here, the train of thought to which it gave rise was by no means of a pleasing or reassuring character. All the more that they knew so much more accurately than is popularly and generally known amongst us, as to what the state of education amongst our working men is. It is difficult indeed to convey any true conception of what this is; it can only be known to the true extent of its "depth of degradation," so to say, by mixing closely and frequently with our working men when actually engaged in carrying on their work. By far too many of them are in a state of almost absolute ignorance of the principles upon which their calling is based, and quite unfitted therefore to "set out work," or to originate new and more ready and economical ways of performing it. Too many amongst them seem to have no conception of the value of thought as bearing upon their work; hence it is that they remain all their lives in the same position, ending as they began, the "mere hewers of wood and the drawers of water" of their trades or callings. And it is only the comparatively few who, impressed with the value of study, and by the mere power which education gives them, force themselves into positions of greater influence, and commanding higher wages ultimately add to the rank of the happy few amongst our working classes who beginning with small things become themselves the employers of labour to a large extent, and the founders, perhaps, of new branches of industry or of art which add so largely to our national wealth.

Deeply impressed with the importance of these views, the gentlemen to whom we have alluded took care to make them known as widely as possible through the media of parliamentary debates, platform lectures, and the various outlets which the press affords, and, backed by a large and influential body of educationists, they have been trying to impress the public mind with the high importance to us as a nation, if we are desirous to maintain the position we have so long held of being the "producers of the world," of developing and working out a thorough system of technical education, and the bringing out of a series of works calculated to afford practical assistance to our working men in improving their minds and through them their material prospects and position. It has been the privilege of the writer to aid somewhat in this movement, and it has been in consequence of his connection with it that the idea of the present series of papers has had its origin. Pretty fairly acquainted with the literature of practical science both of this country and of the Continent—and, from what has been said of the position of the latter in the matter of technical education, it will be readily understood that its literature is particularly rich in valuable works—he has been forcibly struck with the truth, that a vast service would be done to the working classes of the United Kingdom, and also to the rising generation of youths who have tastes in the direction of the technical arts and industries, by the establishment of a well-devised system of education, carried out in special technical schools or classes in ordinary schools, which would bring together and place within the reach, more or less easily, as regards cost, that particular class of practical information likely to be useful to them in their every-day callings and pursuits. This information doubtless can in one sense be said to be already at command, inasmuch as it has been published from time to time in various works. But these are very numerous, and, like all works appealing to certain classes only, are very costly. Their very number, to say nothing of their costliness, precludes the vast majority from having any chance of seeing them, far less of mastering their contents. Those contents, moreover, are not always presented in the form most readily to be availed of, and are too often encumbered with abstruse disquisitions and still more abstruse formulæ and calculations, the key to which few possess; to know these, indeed, another and special knowledge is requisite. We have said, in the second of our papers, that the education of a youth designed to follow one or other of the technical professions is properly divided into two great classes, first, the "education, preliminary to entering the office or works," and second that "which is carried on in these." And we have attempted to show that much of the preliminary education may be conducted at home, although of course the major portion of it will have to be carried on at school. And this brings us to a most important part of our subject, and opens up a question to which it is exceedingly difficult to give a satisfactory reply,—what should be the kind of education given at school, in order to fit a youth, as far as school can render him fit, to carry out the profession or calling for which he is designed, or to which his aptitude and "liking" apparently call him.

No doubt the studies at school ought to have a direct bearing upon the branches useful to the youth in after-life, but the difficulty is in a general school so to arrange the classes that they will form part of the system carrying into practical effect these studies. Hence the value of schools or establishments, the aim of which is the direct instruction of the youths in branches calculated for the technical professions. But even here the difficulty crops up, how to meet the different tastes of youths? is it essential that there be a school for only one branch of technical education, or shall there be distinct branches for each in one establishment alone? Experience would seem to point out the higher practical value of having one establishment only for each particular class of students. Hence we find those who take this view advocating the establishment of agricultural schools, engineering, architectural, and so on. It would appear, however, that such a system is more calculated for the advanced than the earlier stages of education. That the subject is one surrounded with difficulties of no ordinary kind all are at one in agreeing upon, and it will be some time before these will disappear before a system which will meet with general acceptance. What appears at present to be the only way of getting out of the difficulty is to arrange the education of the general school in such a way, that, by special classes, the youths having the like tastes shall have fair opportunities of gaining knowledge likely to be useful to them in the branches they propose to follow. The majority of attempts hitherto made to establish special technical schools or colleges have not succeeded in the sense of turning out commercial successes, that is, they have not paid, having nearly in all instances been supported, while in existence, by special contributions, &c. &c. We, of course, for very obvious reasons, do not include the Government Department of Science and Art at South Kensington in this remark. This fact is, we confess, somewhat humiliating, considering what we as a nation owe to the technical professions; but, humiliating or not, we have to deal with facts as they exist and make the best or the worst of them. That something must be done, so far as regards the working classes at all events, is becoming more and more evident every day, if we mean as a nation to hold our position. This was very strongly pointed out at the important meeting held recently, under the presidency of the Duke of Westminster, to consider the best means to be adopted in establishing a system of technical education throughout the country. The meeting indeed may itself be looked upon as strong evidence of the necessity which exists for taking action in the matter.

While, then, the branches of general education must remain the same, it is obvious that, as each profession concerns itself with different subjects, those branches of knowledge useful for it must be imparted specially to the pupil, either through the medium of special classes, or of special technical schools, to which the pupils would go as to a college or training-school supplementary to or following upon the ordinary scholastic education. And here it is at once confessed that the difficulty is one of no ordinary kind, to engraft upon the usual school system of education such classes bearing upon technical subjects as those we have

already alluded to. Upon this point we shall have yet more to say, but meanwhile we would draw attention to the fact that there is much, very much, even in the ordinary routine of school education, which demands very considerable alteration, in order to render it more practically useful than it is in the disciplining of the minds of the pupils, so that they will have, as it were, the "fallow ground" of their minds so prepared when young, that it will be in a fit condition to receive the seeds of higher knowledge, and to bear the richer crops of wider and more enlarged experience which contact with the outer world will bring with it, but which is so often utterly lost and thrown away, inasmuch as it falls upon literally what is "stony ground," unfitted wholly to receive it. Education, properly so called, is not, indeed—strange as it may seem to some to name it—at all understood by many teachers, so right well satisfied are they if they can only succeed in effecting what has been so graphically designated a "cram." Just as if the mind of the pupil was, so to say, a receptacle or vessel which, if one succeeded in filling with a strange mixture of objects, the process would be deemed quite satisfactorily concluded, without regard ever having been given as to the orderly arrangement of the subjects so crammed within the receptacle; or whether, indeed, they were not of such a nature that, in place of being homogeneous, so to say, they were antagonistic, and would either burst the receptacle, or otherwise cause it to decay, and become weak and worthless. Education proper is, as its very name indicates, an educing or leading out of the powers of the mind, so that it may be strengthened alike as to its desire to obtain information and in its power to avail itself of it; not only storing it up, but so storing it in regular order that it can be made at once available. It is only thus, when the mental powers are exercised, that it gains the strength necessary to enable it to profit not only by what is imparted to it by special means, but, what is of equal importance, to gather from outer sources, as from reading, conversation, or observation, what is lying on all sides of us and everywhere, information of great value and high practical worth. To send a lad into the world, either of the workshop, the factory, or the office, with a mind only "crammed," is to place him under circumstances the full value of which he can neither estimate nor avail himself of, and to which his "cram" is not applicable, or, what is the same thing

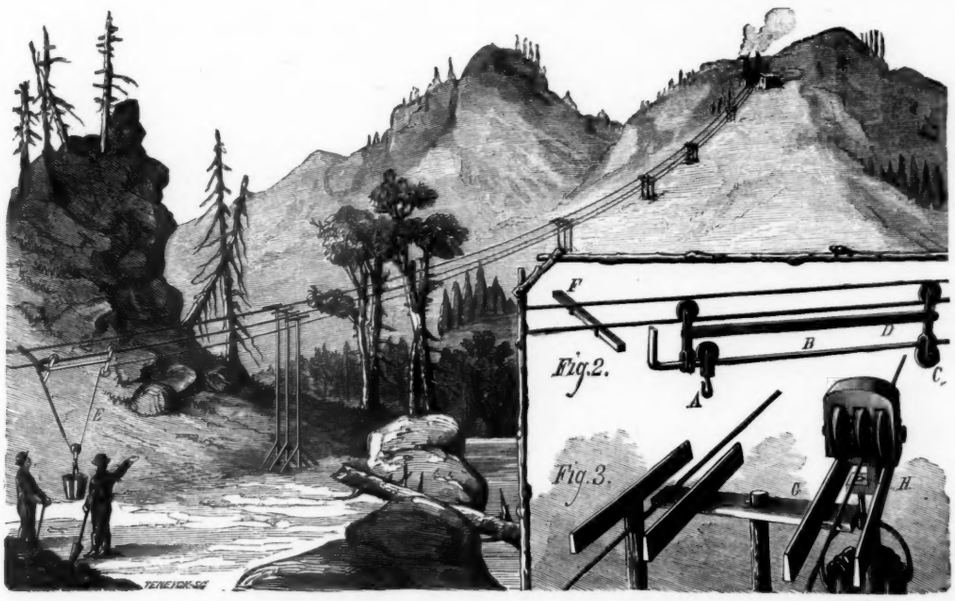


Fig. 2.

Fig. 3.

in its evil results to him, to which he cannot apply it. Whereas by a mind which has gone through a thorough course of mental gymnastics, so to call the training, even although his actual information may be comparatively small in amount, he is able to estimate at their true value the facts and circumstances lying around him; to avail himself of those which he sees practically valuable to him in his calling; to make them available, and so to attach, as it were, things to himself, and, appropriating and retaining them, bring them out from the recesses, so to say, of his mental stores, and make them his willing servants. There is all the difference between a mind educated on the popular principle and one on the special principle we have above briefly alluded to, and which is the only true principle. The leading out, or drawing forth, of the powers of the mind, and making them strong by exercise, is worth, even when done on the smallest, all the "cram" done on the largest, scale.

WIRE WAY FOR TRANSPORTING ORES, &c.

IN the engraving given above is illustrated another of the modern useful arrangements for lowering and raising buckets or cars from or to an elevation, for the purpose of transporting water, minerals, merchandize, &c. The receptacle travels down the way, which may be at any angle to the horizon until it reaches a desired point; there, by mechanism below described, the bucket is caused to descend perpendicularly to a convenient height from the ground for emptying or filling. On returning, the bucket is first lifted up to the way, and then hauled to the elevated point from which it started. This is all done automatically by a motor stationed on the eminence.

In our engraving is shown a general view of the invention, and in figs. 2 and 3 the principal portions in detail. The bucket ready to descend is affixed to the hook, A, which is attached to a pulley which slides freely on the rod, B. The forward portion of the latter is hook-shaped, and is pivoted to a suitable support. The rear end rests upon a pulley, C, in a similar arm. Both supporting arms are provided with wheels above to run on the wire, as shown, and are connected by a rod, D, pivoted to both. The lowering and hoisting rope, E, in the large view is, as represented in fig. 2, attached to the rear end of rod B.

An empty bucket, starting on its downward course, is lowered by the rope, E, until the point at which the filling is to take place is reached. On the way, and directly at such point, is secured a crossbar, F, which the hook end of rod, B, strikes against. The effect of this is to disengage the rear end of rod, B, from the pulley, C, through the action of rod, D, and to allow said extremity to descend. The bucket of course slides down by its own gravity, leaves the rod, and reaches the rope, being finally lowered as represented to the left in the large engraving.

As soon as the receptacle is filled, the motor commences to pull on the rope, and in so doing would naturally drag the car along the ground. This tendency, however, is immediately prevented by resistance of the hook end of rod, B, which, having caught over the crossbar, F, as the opposite extremity descended, retains its hold until the ascending bucket has reached the rod,

B. The gravity of the receptacle causing it to descend to the hook end of rod, B, its weight disengages the hook from the crossbar, leaving the car free to be pulled up the incline.

In fig. 3 is shown the mode of holding up the wire, G being the support. Adjacent to this, in order to allow of the passage of the car, is a short railway, on which the outer wheels of the travelling pulleys, which are threefold, revolve. These being a trifle larger than the middle wheel, the wire will be relieved of the weight of the buckets while the same are passing the supports, and the opening, H, permits the parts which form it to pass with their pendent burden.

The apparatus is adaptable to various uses, and may, it is suggested, be profitably employed when obstacles of any kind exist between localities from one to the other of which the transportation of materials is necessary. *Scientific American.*

ENAMELLING METAL.

THE use of coloured enamels on large surfaces is yet in its infancy. The ordinary grey enamel (so called) is really not an enamel, but a transparent glaze, the apparent grey colour of which is produced by the surface of iron beneath the glaze.

Grey Mixture Enamel.	lbs.	ozs.
Sand	10	0
Red lead	33	0
Boracic acid	20	0
Cullett (broken glass)	114	0
Bicarbonate of soda	16	0
Nitre	1	2
Manganese	0	8½

Grey Mixture Enamel.	lbs.	ozs.
Flint	36	0
Boracic acid	24	0
Bicarbonate of soda	24	0
Nitre	18	0

White Mixture Enamel.	lbs.	ozs.
Cullett	11	0
Boracic acid	7	0
Bicarbonate of soda	0	4
Phosphate of lime	3	8
Oxide of antimony	0	2

A NEW SOURCE OF CAOUTCHOUC.

JUST as the world was beginning to be told that the supply of this useful material was about to become short by reason of the destruction of the tree which produced it, and the thriftlessness which failed to keep up the supply by artificial cultivation, we are also informed of the fact that an entirely new source of supply has been discovered in Burmah, in a creeping plant, whose botanical name is *Chavannesia esculenta*, of the Dogbane tribe; natural order, *Apocynaceæ*, Lindley. The plant is very common in Burmese forests, and is cultivated by the natives for the sake of its fruit, which is said to have an agreeable acid taste, and to mature at a season when tamarinds are scarce. Mr. G. W. Strettel, of Rangoon, has published an interesting descriptive notice on this plant. In 1860, in Mason's "Burma," it was described as yielding an excellent elastic gum, and believed to be *Echites macrophylla*, Wight. Another plant, *Anodendron paniculatum*, in Pegu produces rubber, but far inferior, and less elastic than *C. esculenta*. Measurements of the creepers have been made, which show the thickness of the stem at 5 to 7 years old to vary from 9 to 11 inches in circumference. Assuming the trees to be 30 feet apart, the following details given by Mr. Strettel will enable as to form a fair idea of the probable financial results. Area to be cultivated, 400 acres; trees at 30 feet by 30 feet equal per acre 48, or 19,200 creepers on 400 acres. Minimum yield of caoutchouc per annum estimated at one viss (3lbs. 20z.) per creeper, equal 19,200, or at £20 per 100 viss, £3,840 per annum. The cost of starting this project is trifling in the extreme. All that is necessary ought not to exceed on an average of seven years eight shillings per acre per annum. After the first year the creepers will have attained a sufficient height to require little or no further attention beyond, of course, protection from fire, etc. Thus at the end of seven years the cost on 400 acres would represent £1,120. At the expiration of seven years the expenses will embrace tapping, pressing, and preparing the caoutchouc, which are estimated at 12½ per cent. of the profits. According to these figures and the present market value of the India rubber of this creeper, the net assets of the scheme may be approximated at £3,360 per annum. The milk of this creeper apparently more readily coagulates than that of the *Ficus elastica*. The lactiferous vessels are those that yield the inspissated milk, and when tapping care should be taken not to cut into the sap wood. Mr. Strettel says:—"The cut I adopt is in the form of an arrow, and the incisions are made on the sides of the stem. The tiers of arrows should be three feet apart, and so regulated that the cuts do not come in a perpendicular line with those below. At the point of the arrow I attach a funnel, formed of the leaves of the *Butea frondosa*, which readily attaches itself to the tree, from the glutinous nature of the milk. Any other leaves will answer equally well if sufficiently large and proof against cracking. The season for tapping the trees is about the end of April. Between October and March circulation is slow and milk scarce, but during the rains the milk is more aqueous, and flows more readily. Chemical tests have proved that the rubber of *C. esculenta* is purer and better suited for most purposes than that obtained from the *Ficus elastica*. *Journal of Applied Science.*

THE MANUFACTURE OF ROUGH LEATHER.

NO good reason can be given why female hides should be purged of their gelatin, while those of the male are plumped by all the methods known to the tanner's art. The practical tanner may urge that the female hide is intended for upper, while that of the male is used for sole and belt leather, and (when used for these purposes) he may insist that it should be treated in the manner indicated. But this assumes a necessity which it is our purpose to dispute.

In all the countries of Southern Europe, the full-grown cow hides are manufactured into sole leather; indeed, with the exception of the ox and steer hides brought from South America, the whole supply of sole leather in those countries comes from their cow hides, for they do not raise oxen, but use cows, both as beasts of burden and also to supply the food of the people. This fact shows that cow hides, when properly manufactured, may serve a very useful purpose for sole leather. Besides, it is conceded that cow hides do make a finer-textured leather than ox hides, and they are largely used in the manufacture of "union crop" leather, thus making a large proportion of the finest sole leather for women's and children's shoes. Until within a few years, a greater part of the finer grades of women's shoe leather was thus made from cow hides. When, therefore, female hides, either in France, Germany, or the United States, are used for sole-leather purposes, the tanner finds no difficulty in suitably plumping them, and in making weights which approximate those made from steer or ox hides.

The practical and important economic problem, therefore, arises, whether our tanners are justified in purging and depleting these valuable pelts down to an upper leather substance, even conceding that such a process does make good tough stock. We say, No. We insist that such a tannage is wasteful, and should be abandoned. The boot and pebble grain leather manufacturers have adopted a system of expanding the fibre and plumping the substance which overcomes, to a great extent, the waste here referred to. These manufacturers long since learned that they could not get a round, plump, firm, and fixed grain on a leather depleted in the bath, and tanned with weak, sour liquor. The grain and fibre were too soft and yielding to furnish a grain leather that would hold the impression made by the board or the die. This defect induced the Woburn tanners, long ago, to prepare leather specially for their grain and buff purposes. This special method was confined to that section of Massachusetts for several years, but has now extended to all manufacturers of this description of leather in the country. It consists in suspending the sides in liquor, and tanning them while in this position.

The Woburn tanners tacked the sides on frames, and still continue that practice, as far as we are advised, but many other tanners merely suspend the sides over sticks, and agitate the liquor, either by rocking the sides on frames or plunging them into the liquor, by hand or other power. By either method the same result is reached. The side is plumped in shoulder and offal, and a smooth, round grain is formed, which takes a lasting impression. These qualities add so materially to the economic value of the stock in cutting, whether for shoe or bag purposes, that ordinary upper leather tannage is driven out of competition, and is now seldom used except when, as at present, oak rough tannages are held in excess, and are selling at a loss of three or four cents per pound.

There can be no doubt that boot grain, made from a depleted

CERES. AN AGRICULTURAL PRIZE IN SILVER.

By Christofle and Co., Paris.

tannage, will crimp and possibly wear better than leather raised and tanned as above described; but when enough of the fibre is retained with the grain, as is the case where an eight or even a six-ounce substance is retained, then it is very doubtful whether the old-fashioned tannage presents any advantages over the new. The case is, however, far different where these raised tannages are split down to a light grain or buff substance. In some of these goods little more than the grain itself is retained, while the great bulk of the fibre is split off and goes into trunk and carriage leather. We need not dwell on this practice, nor insist on its damaging effect on the trade.

The custom of colouring and partially tanning on frames suspended in the liquor has improved of late the union crop tannages almost beyond conception. This improvement consists in plumping and making fine the bellies, shoulders, and pates. We assume similar advantages would result to the hemlock and oak rough leather tannages if thus carried on. There is no more difficult task than to find oak rough leather suitable for fine harness and bridle purposes, and much of this difficulty arises from this deficiency of plumpness and fineness in the shoulders and offal. If oak rough leather tanners will adopt our suggestion, and colour and partially tan their stock in a suspended state, they will at once overcome this difficulty, and improve the durability as well as the appearance of their oak rough leather. *Shoe and Leather Reporter.*

Practical Literature.

MAGNETISM AND ELECTRICITY.[1]

STUDENTS who have attended Professor Guthrie's lectures on magnetism and electricity at South Kensington and elsewhere will not, we are sure, be slow to welcome the appearance of this volume. It is based upon the notes of those lectures, and we may at once say that the work is all that his admirers, and they are not few, could have expected from him. The facts of the science are clearly and concisely stated; so concisely, in fact, as to render the style often somewhat hard and rugged; theory is handled sparingly and with care, the work in this respect contrasting favourably with the books by some other writers which have been noticed in these columns, and where the science has become an art the author has not pursued the subject into details unless, to quote his own words, "the art favourably illustrate the science." So closely, however, is the art connected with the science, and so important it is in our opinion that in the present state of electrical knowledge the relations of the two in connection with the most recent practical applications of the latter should be thoroughly understood by the student and the "larger public" for whom the book is written, that we could have wished the author had pursued this branch of his subject somewhat farther. And this leads us to remark upon what we venture to call some other sins of omission which strike us in examining the work. While we have no sympathy with that kind of scientific treatise which is prefaced by a long historical retrospect, yet the early discoveries of the facts of a science are always interesting, and the methods by which they were made may not be without use in the education of the student. For these reasons we should have been glad, although the book is not, as the author states, a history of discovery, if he had, however briefly, glanced at the various steps by which our knowledge of the subject has been gained; and, on reading the few curt words in which he has stated his reasons for so doing, there is almost provoked a feeling that he has acted ungraciously in his omission of the names of the great men who have laboured in the science, and to whose discoveries we are all so largely indebted.

We are somewhat at a loss to understand why the illustrations in the book are not drawn to scale, their being not so drawn gives a curious appearance to some of them; and in our opinion the principles might have been illustrated equally well had this been done, while their practical value would, we think, have been increased.

We miss in the work one other feature which, we think, would have largely increased its value, both for the student and others for whom it is intended, viz., practical instructions for the construction of apparatus. We are aware that the students at South Kensington have ample opportunity of obtaining such instructions, but comparatively few are enabled to avail themselves of the advantages there offered. The work by Mr. J. T. Sprague, which we received some time since,[1] contained very full and valuable information of this kind, and we should have been glad if Professor Guthrie had supplied this important *desideratum*. Of the value of practical work in acquiring a knowledge of the subject the Professor is of course fully aware, and we are, therefore, the more surprised at his not having done so.

The reader may think that in referring to these matters we are somewhat hypercritical, but all that we shall now have to say of the book can only be in praise. These peculiarities—omissions we have called them—are referred to in the preface in that steady, abrupt style which the Professor affects, and they naturally provoke comment at the outset.

And now to continue our much more pleasing task of pointing out the excellencies of the work. For the student, as we have hinted, the work is invaluable; he will find in it such an abundance of technical information as no other work on the subject gives, and there is no better book for educational purposes than this.

To those interested in the practical application of scientific discovery there is one part of the work that will possess a special attraction and value, to which they will at once turn on opening it. We refer to the sections on electro-magnetic machines, and the remarks upon their use as prime movers. Not a large space is devoted to the subject, but its pros and cons are stated here in a very complete manner, and we commend the attention of our readers to Professor Guthrie's concise statement of them. The description of the electric telegraph, though short, is comprehensive and, in keeping with the rest of the work, entirely to the point.

In conclusion, for we must now bring our notice of this interesting work to a close as space will not admit of our giving more descriptive details of it, we may thank Professor Guthrie for his contribution to the literature of this important science, and earnestly hope that he may long continue his investigations in the rich mine in which he is now working with such zeal and success.

BRITISH MANUFACTURING INDUSTRIES.[2]

UNDOUBTEDLY the idea of this series of books is a good one, and, if it be well carried out, the series cannot fail to prove of real value and of extensive popularity. Its object, as stated in the prefatory notice, is "to bring into one focus the leading features and present position of the most important industries of the kingdom, so as to enable the general reader to comprehend the enormous development that has taken place within the last twenty or thirty years." There is, no doubt, a very large class of people to whom such a series of books, written in a non-technical style, and yet with a more accurate knowledge of the subjects than is usually shown in the ordinary newspaper article descriptive of British industries, would be very acceptable, and with such a public a cheap series of books of this kind cannot fail to become popular.

In the three volumes before us, the first of the series, we have the following subjects treated of:—iron and steel, by W. Mathew Williams, F.R.A.S., &c.; copper smelting, by J. Arthur Phillips, M.I.C.E.; brass founding, tin plate, and zinc-working, by Walter Graham; pottery, by L. Arnoux, art director, &c., of Minton's factory; glass and silicates, by Prof. Barff, M.A.; furniture and wood-work, by J. H. Pollen, M.A., South Kensington Museum; hosiery and lace, by the late W. Felkin; carpets, by Christopher Dresser; dyeing and bleaching, by T. Sims. The different sections of each volume have, it will be seen, each been written by a competent authority. They are generally couched in brief but pointed language, sufficiently devoid of technicalities to enable the general reader to grasp the main principles of the subject with ease, and yet by no means wanting in accuracy and freedom from superficiality. The plan of each writer seems to be to rapidly survey the rise and growth of each manufacture, to note the phases it assumes in various countries and under varying circumstances, and finally to describe, always with the same absence of minute detail, and yet always with enough of particulars to enable the reader to understand the *modus operandi*, the present condition and methods employed in working the special industry treated of.

In some instances there seems a tendency on the part of the writer to enter too fully upon the historical aspect of his subject, giving too little of the details of the present methods of manufacture, while in others there may be a tendency to dwell unduly

[1] *Magnetism and Electricity*. By Frederick Guthrie, Professor of Physics at the Royal School of Mines. With 300 illustrations. London and Glasgow: William Collins, Sons, and Company.

[1] See "Practical Magazine," June, 1875, No. 6, New Series.

[2] *British Manufacturing Industries*. Edited by G. Phillips Bevan, F.G.S. London: Edward Stanford. 1876.

upon the latter feature, thus dwarfing the historical and general view of the subject. It is important that each part should be carefully adjusted and balanced, so to speak, and we do not doubt that this series, when completed, if the remaining volumes keep up to the promise of those we have before us, will furnish a valuable nineteenth century Cyclopædia of our British Industries.

TIMBER AND TIMBER TREES.[1]

ALL who are engaged in working in wood in any form, as well as students in carpentry, engineering, shipbuilding, &c., will fined in this work, embodying as it does the experience gained during a long course of practice in the working of forests and in the official capacity of timber inspector to the Admiralty, an invaluable companion. It is based on lectures delivered by the author at the Royal School of Naval Architecture at South Kensington, and at the Royal School of Military Engineering at Chatham. These have, of course, been largely extended, and the work is one of the most complete treatises that we have seen on the subject. The first part treats of the general characteristics of timber from the botanical point of view, of the effects of various external influences upon its growth and development, of the different defects which are to be found in it, and the methods of readily detecting them. Each kind of wood is then dealt with in a separate chapter, which indicates the places from whence the supply is chiefly drawn, the best varieties which are to be obtained, the manner in which it comes into the market, the methods of preparing it for this purpose, and the various uses to which it is applied, the chapter being supplemented by tables of transverse and tensile experiments upon various samples of the particular wood treated of. These tables are a most valuable feature of the book, and, as they show for the most part the result of experiments personally conducted by the author or derived from official sources, they are the most trustworthy that can be found.

A vast amount of information of real practical value is to be found in each chapter that is not indicated by the general outline of their contents which we have just given, and many curious and little-known kinds of timber are described. The various natural and artificial methods of seasoning timber are dealt with in a chapter by itself, and an abstract of the tables scattered throughout the book is given at the end of the volume, which, as a concise and complete handy-book on home and foreign timber for ship and house-building purposes, we have pleasure in recommending to those of our readers who are interested in the subject.

LANGUAGE.[2]

WE have great pleasure in inviting the attention of our readers to this excellent little volume—one of the best and one of the most important that have appeared in Messrs. Chambers' justly popular series of science manuals. Perhaps, to the reader coming fresh from the perusal of the larger work by Professor W. D. Whitney on the "Life and Growth of Language" this book might seem to be almost entirely built upon the foundation which he has laid, yet we cannot in any sense accuse the author of plagiarism. The science of language, which is daily assuming so important a position, is one which has as yet been treated of by comparatively few persons, and in preparing a manual of it these authors must necessarily be laid under contribution. Dr. Findlater's manner of treating the subject is, however, one entirely his own, and we confidently recommend his book as an introduction to the larger works on philology which are published, while we have no hesitation in saying that the student who has mastered its contents will have grasped all the important principles of the science which modern research has discovered and laid down. We cannot do better than quote the following extract from the preface, as indicating the aim and scope of the book: "The term (the science of language) is not to be understood as meaning a knowledge of languages for practical use, but the physiology, as it were, of speech in general, and the scientific classification of the various tongues spoken by men. The study of language from this point of view, though of recent origin, possesses an interest that is not confined to learned philologists, and an attempt is here made to present such an outline of the subject as may be intelligible to the ordinary reader."

[1] *Timber and Timber Trees; Native and Foreign.* By Thomas Laslett. London: Macmillan and Co. 1875.

[2] *Language.* By Andrew Findlater, M.D. Chambers' Elementary Science Manuals. London and Edinburgh: W. and R. Chambers. 1875.

ELEMENTS OF ANIMAL PHYSIOLOGY, CHIEFLY HUMAN.[1]

PERHAPS there is no subject of more importance as a branch of popular education than that of animal physiology, and certainly students have no cause to complain of want of books to enable them to prosecute their studies. If we are to judge from the number of treatises on, manuals of, and introductions to the subject which are published, and the large sale with which they meet, from the excellent work of Professor Huxley downwards, there is no lack of general interest in the subject, and those who have advocated the importance of its claims are already seeing the result of their labours.

The work before us is one of Messrs. Collins' elementary science series, and has been written with the right object, viz., that of "cultivating the higher reasoning powers of the young student in dealing with the principles of the science, rather than encouraging in him the acquisition of the power of mere 'descriptive cram.'" With this view, although intended for the use of students preparing for the examination of the Science and Art Department in elementary physiology, the range of the work is extended beyond the syllabus issued by the South Kensington authorities.

The work is one of practical usefulness. It is written in a clear and straightforward manner, and is illustrated copiously throughout. We do not, however, quite see the necessity for the paragraph with which the book is opened, on the harmony of physiology and theology. We should not have thought that in such an elementary work there would be any possibility of confusion arising as to the author's views on this subject, and we certainly do not think it wise, even from the author's own point of view, to call the attention of the beginner to such a vexed question as the nature of the human soul and the connection of mind and body. This may be safely left until the student, having mastered the science of physiology, is able to enter into the speculations of the great writers who have dealt with the subject.

A PRACTICAL MANUAL OF HOUSE-PAINTING, GRAINING, MARBLING, AND SIGN-WRITING.[2]

MR. DAVIDSON is well known as a writer of that popular technical kind of literature which is so increasingly abundant just now; his books for the most part are distinguished by a pleasant, easy style, considerable skill in compilation, and a tendency to moral reflections whenever an opportunity presents itself to him to indulge in them. This latter characteristic is not, however, so prominent in the work before us as in some which we have seen, and the only unfavourable criticisms we have to make upon this book are, compared with the usefulness of the greater portion of it, of a very minor character. So long as Mr. Davidson confines himself to receipts and descriptions of processes culled from other works, both English and foreign, the artizan who follows him will be little likely to go wrong; but there are others which have not that practical value which every hint given in a work intended for practical use should possess—and these may, in some cases, prove stumbling-blocks to the workman who takes Mr. Davidson as his guide. These are, however, as we have indicated, in very small proportion to the great mass of useful matter in the book, and those portions which treat of the higher and theoretical aspects of the subjects dealt with are in every way excellent and deserving of careful attention.

The book discusses the processes of painting in oil and distemper, of the colours used in house-painting, of graining and marbling, of oils and varnishes used in house-painting, of letter-painting, of the principles of decorative art, of elementary drawing for house-painters, decorators, and sign-writers, and of staining; a collection of useful receipts, and a carefully compiled index completes the list of its contents, and the work is illustrated by some excellent coloured plates, illustrating various styles of graining and marbling.

As another effort to instruct our artizans and to teach them

[1] *Elements of Animal Physiology, chiefly Human.* By John Angell, Senior Science Master, Manchester Grammar School. London and Glasgow: William Collins, Sons, and Co. 1875.

[2] *A Practical Manual of House-Painting, Graining, Marbling, and Sign-Writing.* By Ellis A. Davidson. London: Crosby Lockwood and Co. 1875.

the principles on which their practical operations are founded, we welcome this book, and have no hesitation in recommending it to those who are engaged in the branches of which it treats; but we should suggest that, before another edition is issued, Mr. Davidson should avail himself of the aid of a practical painter and grainer—which we infer he is not—in carefully revising the details of some of the recipes.

OUTLINES OF NATURAL HISTORY.[1]

WRITTEN in a pleasant and readable style, is this rapid survey of the mineral, vegetable, and animal kingdoms, compiled for the use of the youthful reader, and possessing many characteristics of a very useful nature—not the least of which is the avoidance of the technical terms used in these branches of science, the actual English meaning of them being given instead, and the scientific terminology indicated by foot-notes. To present even the outlines of natural history in less than 200 pages necessitates the omission of a vast quantity of details; but most of the broad principles will be found here, and as a first book on the subject to put into the hands of the young, with a view of inciting them to a further pursuit of knowledge in the same direction, the book has, we doubt not, been found useful, and will continue to be so.

THE TIMBER IMPORTERS', TIMBER MERCHANTS', AND BUILDERS' STANDARD GUIDE.[2]

THE value of a collection of tables and of calculations such as are found in this work does not need to be pointed out. It is intended to facilitate the operations of the timber merchant in fixing costs, and to guide the foreign agent in purchasing goods suited for particular home markets. The tables are arranged with equivalent values in dollars, currency, and sterling, and the distinctive features of mercantile arrangements in various countries with which the important branch of the timber trade is carried on have due attention. For the builder and salesman a list of values of the various kinds of work which they handle are given, and the book seems to be arranged with that conciseness and ease of reference which is so necessary in a work intended to be constantly used and consulted. We have not had an opportunity of testing the accuracy of the calculations and of the pricing, but we have no doubt that in this second revised edition careful attention has been given to such details as these.

THE WORKMAN'S MANUAL OF ENGINEERING DRAWING.[3]

THIS is one of the well-known "Weale's Series," and will be found a useful book, both for the working engineer and for the student. This third edition has been carefully revised, and in its present form gives full instructions in mechanical drawing for engineers, dealing first with the materials with which to work, then giving some useful hints on geometry, and afterwards treating of the various methods of producing the drawings required in the draughtsman's office of an engineering establishment. Although the directions are very clear and full, and, if followed with care, would no doubt make the student a qualified draughtsman, yet some assistance from a master is always desirable. If this, however, be unattainable, the earnest worker may learn much from the book, the illustrations being numerous and carefully prepared, and the appendix, while dealing with matters closely connected with the subject of engineering work, will give an insight into the wider applications of mechanical drawing.

[1] *Outlines of Natural History.* By A. H. Dick, D.Sc. (Edin.), M.A., LL.B. (London.) With 47 illustrations. London and Glasgow: W. Collins, Sons, and Co. 1874.

[2] *The Timber Importers', Timber Merchants', and Builders' Standard Guide.* By Richard E. Grandy. Second Edition, revised. London: Crosby Lockwood and Co. 1875.

[3] *The Workman's Manual of Engineering Drawing.* By John Maxton, Engineer, &c. Third Edition, carefully revised. London: Crosby Lockwood and Co. 1875.

INTRODUCTION TO PRACTICAL FARMING.[1]

WE believe this is the first attempt that has been made to present a complete view of the science of farming in a small compass for scholastic purposes. Large treatises on the subject already exist, and there are two or three books so well known, and so often quoted as authorities on this important branch of science, as to make the publication of another work appear almost superfluous. But this little book has such special and, to our mind, such valuable features, as to make us wonder that there has not arisen such a demand as would have produced a work of the kind long since. It is, however, only within comparatively recent years that the subject has received the scientific treatment that is now accorded to it; and although there exists, among those men who have given much time and attention to it, much difference of opinion with respect to many of its fundamental principles, yet these can now be so definitely formulated as to place them within the comprehension of the rising generation, and to enable them to form part of their studies.

Beginning with first principles, the author describes the exhaustion of the land, and the methods of recruiting it, discussing the various kinds of manure, and methods of manuring. The land thus prepared for action, the various crops are considered and how to grow them, the different kinds of rotations of crops in various parts of the country being briefly but clearly described. The live stock of the farm is next treated of, and in this section is a chapter on dairy management. The question of the food of the different animals is also fully entered into, and the principles of their breeding, rearing, and fattening are set forth. The section which treats on cottage gardening is full of useful information, and this naturally leads us to the larger subject of farm management, which is treated of with fulness and care. The often-discussed question of large *versus* small farms, of course, comes up here; but the practical management of the farm is treated of rather than the larger questions of policy which have formed the main element in the consideration of the subject.

The book is written in clear, vigorous style. The arrangement of the matter, as we have indicated in summarizing the contents of the book, leaves little or nothing to be desired. We could have wished, however, that it had included the very necessary appendage of an index.

PROGRESSIVE LESSONS IN APPLIED SCIENCE.[2]

THE third part of Mr. Sang's lessons in applied science realizes to the full the promise of the two former ones, of which we recently had occasion to speak in favourable terms.[3] The student is here led to the higher branch of trigonometry (which, by the way, Mr. Sang would like to call gonometry on etymological grounds), and, after an exposition of the principles of measuring angles, is instructed in the use of the instruments designed for that purpose. The same clear and lucid style characterizes this as the other two volumes, while the practical applications of the principles reasoned out in the earlier portion of the book are of an exceptionally useful character.

THE ENGINEER'S ANNUAL AND ALMANAC FOR THE YEAR 1876.[4]

THIS annual contains a great quantity of useful information, and tables for engineers and others interested in practical matters. It is cheap, and will, doubtless, be found useful. In addition to the usual features of an almanac and those special characteristics above referred to, it contains a diary ruled for memoranda.

[1] *Introduction to Practical Farming, for the use of Schools.* By Thomas Baldwin, M.R.I.A. London: Macmillan & Co. 1875.

[2] *Progressive Lessons in applied Science. Part III. Trigonometry, Vision, and Surveying Instruments.* By Edward Sang, F.R.S.E. London: E. and F. N. Spon. 1875.

[3] See "Practical Magazine," N.S., No. 11, p. 350.

[4] *The Engineer's Annual and Almanac for the year* 1876. D. M'Gregor & Co. Glasgow.